DANA SPICER®
Off-Highway Products

Service Manual

Powershift Transmission
TE10 3-Speed Short Drop
with Full Flow Control Valve

TSM-0050
April 2011

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TOWING OR PUSHING

Before towing the vehicle, be sure to lift the driven axle wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

NOTE:

Because of the design of the hydraulic system, the engine cannot be started by pushing or towing.

INTRODUCTION

Foreword

This manual has been prepared to provide the customer and maintenance personnel with information and instructions on the maintenance and repair of Dana Spicer products.

Extreme care has been exercised in the design, selection of materials, and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and adjustments as indicated will be reimbursed many times in low cost operation and trouble-free service.

In order to become familiar with the various parts of the product, its principle of operation, troubleshooting, and adjustments, it is urged that mechanics study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required, only Dana Spicer approved parts, as listed in the applicable service parts list, should be used. Use of “will fit” or non-approved parts may endanger proper operation and performance of the equipment. Dana does not warrant repair, replacement parts, or failures resulting from the use of parts which are not supplied or approved by Dana.

IMPORTANT:

ALWAYS FURNISH THE DISTRIBUTOR WITH THE SERIAL AND MODEL NUMBER WHEN ORDERING PARTS.

Safety Precautions

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed. Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the machine. If replacement parts are required, the part must be replaced with a Dana specified replacement part. NEVER use a replacement part of lesser quality.

The service procedures recommended in this manual are effective methods of performing service and repair. Some of these procedures require the use of unique tools. Accordingly, anyone who intends to use a replacement part, service procedure, or tool, which is not recommended, must first determine that neither their safety or the safe operation of the machine will be jeopardized by the replacement part, service procedure, or tool selected.

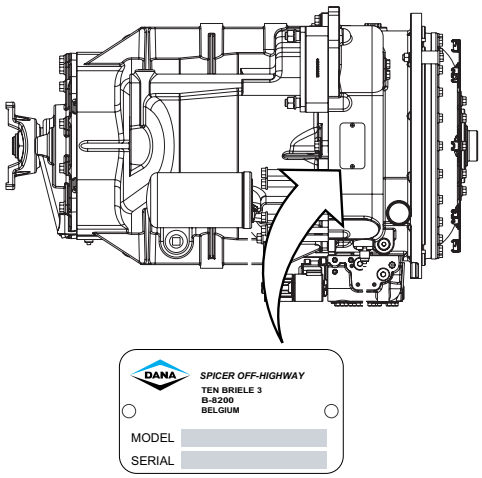
It is important to note that this manual contains various precautions that must be carefully observed in order to reduce the risk of personal injury during service or repair. Improper service or repair may also damage the unit or render it unsafe. It is important to understand that these precautions are not exhaustive. It is impossible to warn of all possible hazardous consequences that may result from following or failing to follow these instructions.

DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury.
NOTICE	Indicates a situation which, if not avoided, may result in damage to components.

SPECIFICATIONS

Identification Tag

The nameplate contains both the model and serial number of the unit.



General Specifications

Weight (dry)	± 800 lbs / 360 kg
Length (maximum)	31.7” / 805 mm
Width (maximum)	20.7” / 526 mm
Height (maximum)	30.8” / 783 mm
Oil Capacity	+ 6.7 US gallons / 25.6 liters*

* *Without cooler and hydraulic lines. Consult equipment operator’s manual for complete system capacity.*

Hydraulic Cooler Lines Specifications

Lines and Fittings (Minimum)	0.75” / 19 mm internal diameter
Continuous Operating Temperature	ambient to 248°F / 120°C
Continuous Pressure	435 PSI / 30 bar continuous pressure and 652 PSI / 45 bar intermittent surges
Conformance	SAE J1019 and SAE J517, 100RI

Pressure and Temperature Specifications

Normal Operating Temperature	158-248ºF / 70-120ºC Measured at temperature check port converter out (port 71-*)
Maximum Temperature	248ºF / 120ºC
Regulator Pressure†	Vehicle in Neutral & Port 31* At 600 RPM minimum: 250 PSI / 17.2 bar minimum At 2200 RPM: 290 PSI / 20.0 bar maximum
Pump Flow†	At 1800 RPM 19.6 GPM / 74.5 l/min minimum
Clutch Pressure†	1st clutch: Port 41* 2nd clutch: Port 68* 3rd clutch: Port 43* Forward clutch: Port 45* Reverse clutch: Port 46* At 2000 RPM: 250-290 PSI / 17.2-20.0 bar clutch activated 0-3 PSI / 0-0.2 bar clutch released
Filter Bypass Valve†	Set at 30-50 PSI / 2.1-3.4 bar
Lube Pressure†	Port 33/34 7.2-11.6 PSI / 0.5-0.8 bar at 17 GPM / 64.3 l/min pump flow ±1500 RPM
Safety Valve Cracking Pressure†	120-175 PSI / 8.2-12.1 bar
Converter Out Pressure†	Port 32 25 PSI / 1.7 bar minimum 2000 RPM and maximum 70 PSI / 4.8 bar at no load governed speed

* *Refer to "Troubleshooting", see page 36, for check port identification.*

† *All pressures and flows to be measured with oil temperature 180-200ºF / 82-93ºC.*

Electrical Specifications

Electrical Specifications

Proportional Valves	FWD/REV - 1st/3rd - 2nd Coil Resistance: 7.25Ω at 68°F / 20°C
Selection Valves	FWD/N/REV - 1st/3rd Coil Resistance: 28.5Ω at 68°F / 20°C
Speed Sensor	Type: Magneto resistive sensor Sensing Distance: 0-0.07" / 0-1.8 mm Sensor Signal: Generates a square current with a fixed amplitude changing between 7 and 14 mA.
Temperature Sensor	Material: Silicon Resistance: 77°F / 25°C = 2000Ω ± 1%
Pressure Sensor	Supply Voltage: 4.5-5.5V Maximum Current: 10mA Pressure Range: 14.5-450 PSI / 1-31 bar ± 1.2% full scale (450 PSI / 31 bar) range 14.5-363 PSI / 1-25 bar ± 2.5% full scale (450 PSI / 31 bar) range 363-450 PSI / 25-31 bar

Temperature Sensor

Ambient Temperature °C	**Resistance Ω**
-50	1040
-30	1250
-10	1500
10	1770
25	2000
30	2090
50	2400
70	2800
90	3180
110	3630
130	4050
150	4490

MAINTENANCE

Recommended Lubricants

Only Dextron® III is approved.

Sump preheaters

Preheat the transmission fluid to the minimum temperature for the oil viscosity used before engine start up.

Normal oil change interval

Drain and refill system every 1000 hours for average environmental and duty cycle conditions. Severe or sustained high operating temperature or very dusty atmospheric conditions will result in accelerated deterioration or contamination. Judgement must be used to determine the required change intervals for extreme conditions.

Extended oil change interval

Extended oil service life may result when using synthetic fluids. Appropriate change intervals should be determined for each transmission by measuring oil oxidation and wear metals, over time, to determine a baseline. Wear metal analysis can provide useful information but a transmission should not be removed from service based solely on this analysis.

Filters

Service oil filters element every 1000 hours under normal environmental and duty cycle conditions.

Maintenance Intervals

Daily

Check oil level daily with engine running at idle (600 RPM) and oil at 82 - 93 °C [180-200 F].

Maintain oil level at full mark.

Normal drain period

Normal drain period and oil filter element change are for average environment and duty cycle condition.

Severe or sustained high operating temperature or very dusty atmospheric conditions will cause accelerated deterioration and contamination.

For extreme conditions judgement must be used to determine the required change intervals.

Every 1000 hours:

- Change oil filter element.
- Drain oil at 150–200°F / 65-93°C and refill system as follows:

1. Drain transmission.
2. Remove and discard filter. Install new filter.
3. Refill transmission to FULL mark.
4. Run engine at 500 - 600 RPM to prime converter and lines.
5. Recheck level with engine running at 500 - 600 RPM and add oil to bring level to LOW mark. When oil temperature is hot 180-200°F / 82.2-93.3°C make final oil level check and adjust if necessary to bring oil level to FULL mark.

NOTE:

It is recommended that oil filter be changed after 100 hours of operation on new, rebuilt, or repaired unit.

Every 2000 hours:

Perform Automatic Clutch Calibration

Servicing Machine After Component Overhaul

The transmission, torque converter, and its allied hydraulic system are important links in the driveline between the engine and the wheels. The proper operation of either unit depends greatly on the condition and operation of the other. Therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered complete.

After the overhauled or repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgement must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.
3. Replace oil filter element.
4. The oil cooler must be thoroughly cleaned. The cooler should be “back flushed” with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, cooler assembly should be removed from machine for cleaning, using oil, compressed air, and steam cleaner for that purpose.

IMPORTANT:

NEVER use flushing compounds for cleaning purposes.

5. Reassemble all components and use only type oil (See chapter 4.1.1 “Recommended lubricants”).
   Fill the transmission through filler opening until fluid comes up to FULL mark on transmission dipstick.

- Remove filler plug and fill oil until FULL mark.
- Run engine two minutes at 500 - 600 RPM to prime torque converter and hydraulic lines.
- Recheck level of fluid in transmission with engine running at idle (500 - 600 RPM).
- Add quantity necessary to bring fluid level to LOW mark on dipstick.
- Recheck with hot oil 180 – 200°F [82.2 - 93.3°C].
- Adjust oil level to FULL mark on dipstick.

6. Recheck all drain plugs, lines, connections, etc… for leaks and tighten where necessary.
7. Perform automatic calibration.

Automatic Calibration Procedure

Introduction

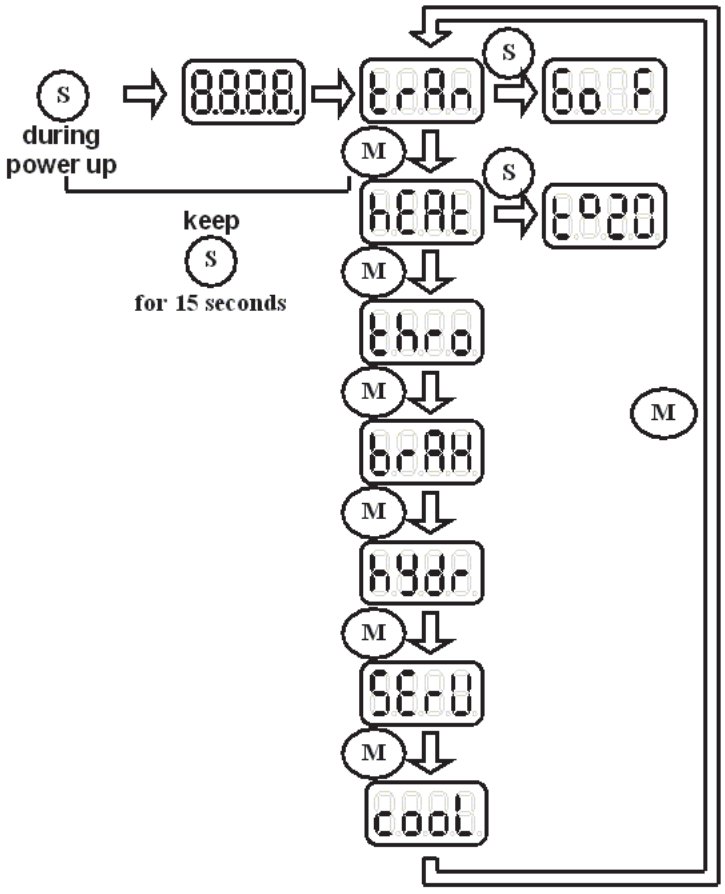
The APC200 firmware contains an automatic transmission calibration procedure, which is able to optimize the shift quality of the transmission.

An automatic calibration has to be done:

- When the vehicle is build at the OEM
- Every 2000 hours of transmission operation
- When an overhaul of the transmission is done
- When the transmission is repaired
- When the APC200 is replaced

ENTERING AUTOMATIC CALIBRATION MODE

The automatic calibration mode is entered by pressing the S-button on the APC200 display for 15 seconds during power-up.



Automatic Calibration Procedure

PERFORMING AUTOMATIC CALIBRATION

Before the automatic calibration can be started, a number of conditions need to be fulfilled:

- The parking brake on the vehicle has to be activated.
- The transmission temperature needs to be above 60°C. See the next paragraph how to use the ‘HEAT’-mode to do this in a time effective way.
- The engine speed has to be kept at around 800 rpm (± 200 rpm) during the complete calibration. If the APC200 has control over the engine, the engine speed will be adapted automatically.

1. If all the conditions mentioned above are met, the actual automatic calibration can be performed starting from the following display on the APC200:

2. To trigger the automatic calibration procedure, push the S-button once. The APC200 display readout will show:

3. The APC200 asks for the shift lever to be put in FORWARD.
   The automatic transmission calibration procedure starts. This is indicated on the APC200 display:

   ‘C1’ stands for ‘clutch 1’ being forward, while ‘M1’ stands for ‘mode 1’ of the calibration.

4. When all clutches have been calibrated, the APC200 displays:

5. At this point, the automatic calibration has completed successfully. The normal duration of a complete transmission calibration is around 15 minutes.
6. To exit the automatic calibration mode, switch off the vehicle ignition key. Make sure that the APC200 has powered down – wait for 2 seconds. Now restart the vehicle and the new tuning results will be activated automatically.

Troubleshooting

If anything different than described above appears on the APC200 display, there can be two possible reasons:

- The calibration conditions are not fulfilled (temperature is too low, parking brake switched off, the vehicle is moving, engine rpm is too high or too low).
- A calibration error has occurred during the calibration. This message starts with an ‘E’ (see “CALIBRATION CONDITION MESSAGES AND CALIBRATION ERRORS”, on page 11).

By selecting REVERSE on the shift lever, while the automatic calibration is performing, the procedure will abort the automatic calibration immediately and restart the APC200. This feature can be used when something goes wrong during the calibration procedure.

NOTE:

By aborting the automatic calibration, the calibration is not finalized and needs to be done from the beginning.

HEATING UP THE TRANSMISSION BY USING THE 'HEAT'-MODE

The 'HEAT'-mode allows to select forward / reverse while the parking brake is activated, without forcing neutral and will disable the inching and declutch function. During the heat mode the highest gear is forced – even when the shift lever is in a lower gear. This combination allows the driver to heat up the transmission by going into stall.

'HEAT'-mode can be activated in the same way automatic calibration mode is entered (see "ENTERING AUTOMATIC CALIBRATION MODE", on page 8). Once "tran" is displayed on the screen, press the M-button once to go into the "HEAT"-mode. The APC200 will display:

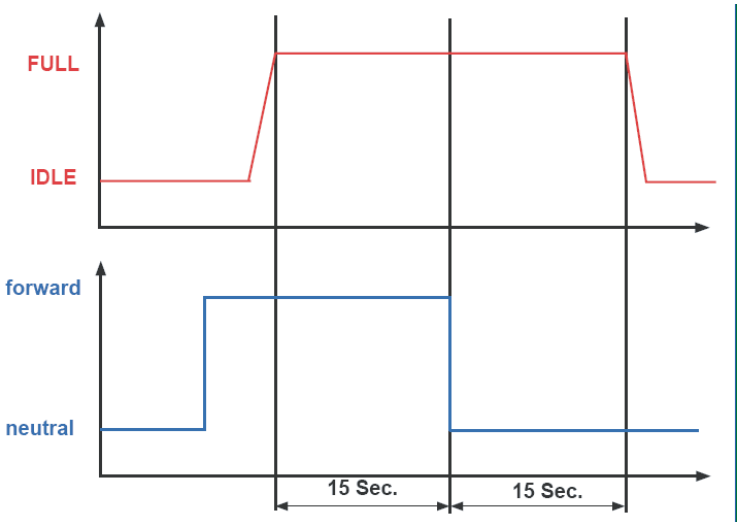
To trigger the 'HEAT'-mode, push the S-button. The APC200 will display the sump temperature:

This means the actual sump temperature of the transmission is 20°C.

Perform the following steps in order to heat up the transmission:

1. Make sure the parking brake is active and works properly.
2. Put the transmission in forward by selecting forward with the shift lever and then accelerates the engine to full throttle.
3. Keep the engine at full throttle for about 15 seconds and then put the gearbox in neutral by selecting neutral with the shift lever. Keep the engine at full throttle!
4. Keep the gearbox in neutral at full engine throttle for about 15 seconds again.
5. Release the throttle pedal and decelerate the engine to idle.
6. Go back to point 2 and repeat until the APC200 display shows a temperature above 60°C. When the temperature is above 60°C, the temperature indication on the display starts blinking. Now switch to automatic calibration by pressing the M-button several times – until the APC200 displays "tran".

During this warm up procedure, it is possible for the converter out temperature of the transmission to exceed the maximum limit. This is a consequence of heating up the transmission using this quick procedure. When this occurs, the engine speed will be limited to half throttle when the APC200 has engine control or forcing neutral when the APC200 has no engine control. To solve this, simply leave the transmission in neutral for a minute and throttle the engine to around 1300 rpm. This will allow the heat in the converter to be evacuated. After one or two minutes, resume the heating up procedure if the transmission temperature has not reached 60°C yet.



Automatic Calibration Procedure

CALIBRATION CONDITION MESSAGES AND CALIBRATION ERRORS

This chapter gives an overview of the most common calibration condition messages. Many calibration condition messages can be corrected, however, if any calibration error messages appear, contact the OEM of the machine.

Calibration Condition Messages

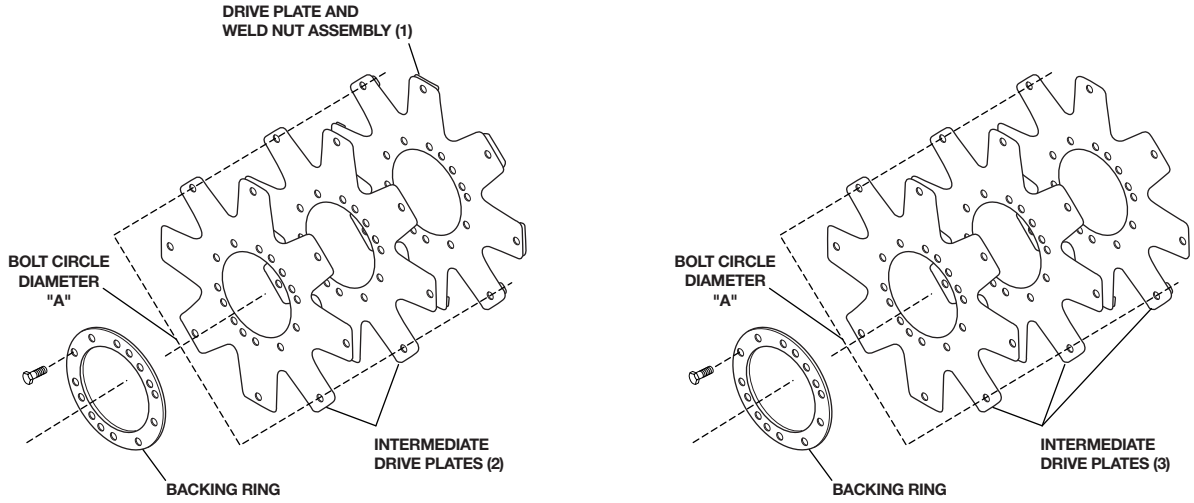
	The APC200 expects the shift lever to be in NEUTRAL, but finds it in another position. (FORWARD or REVERSE)	Put the shift lever back in NEUTRAL.
	THE APC200 expects the parking brake to be ON while it is OFF.	Put the parking brake ON.
	The APC200 has detected output speed.	Verify that the parking brake is ON and working properly. If this is already the case, keep the machine at standstill by using the brake. Once the machine has been stopped, the APC200 will ask the driver to shift to FORWARD before continuing the calibration.
	Engine RPM is to low according to the limit that is necessary for calibration.	When during the automatic transmission calibration the temperature becomes to low, the APC200 display indicates the actual transmission temperature.
	Engine RPM is to high according to the limit that is necessary for calibration.	
	After being to low or to high, the engine RPM is coming back into the correct boundaries for calibration.	
	When during the automatic transmission calibration the temperature becomes to low, the APC200 display indicates the actual transmission temperature.	Use the M-button on the APC200 to go back to the 'HEAT' mode and the S-button to trigger this mode. Then warm-up the transmission again until the temperature is above 140°F [60°C]. Then go back to the automatic tuning mode by the M-button and trigger this one again to continue calibration.

Calibration errors

Calibration errors have the form ‘E1.xx’ or ‘E2.xx’ (example: E1.25). Please contact the OEM of the machine if an error of this form appears on the display.

DRIVE PLATE INSTALLATION

Proper identification is determined by measuring the bolt circle diameter (see dimension “A” in the illustration below) and then ordering the appropriate drive plate kit from the table.



Each kit includes: 2 Intermediate Drive Plates 1 Drive Plate & Weld Nut Assembly 1 Backing Ring 10 Mounting Capscrews 10 Lockwashers Instruction Sheet	Each kit includes: 3 Intermediate Drive Plates 1 Backing Ring 10 Mounting Capscrews 10 Lockwashers Instruction Sheet
11.380” [288.9 mm] diameter	11.380” [288.9 mm] diameter
13.120” [332.2 mm] diameter	13.120” [332.2 mm] diameter
13.500” [342.9 mm] diameter	13.500” [342.9 mm] diameter

1. Position drive plate and weld nut assembly on torque converter assembly with weld nuts toward converter.
2. Align intermediate drive plates and backing ring with holes in torque converter assembly.
3. Two dimples 180^{o} apart in backing ring must be facing outward toward engine flywheel (hollow side facing torque converter assembly).
4. Install capscrews and lockwashers. Tighten capscrews to 30-37 lbs. ft. (40-50 N•m).

NOTE:

Assembly of all plates must be completed within 15 minutes from when screws are installed. If a screw is removed for any reason it must be replaced. The adhesive left in the tapped holes must be removed with the proper tap and cleaned with solvent. Dry the hole thoroughly and use a new screw for reinstallation.

TRANSMISSION TO ENGINE INSTALLATION

1. Remove all burrs from flywheel mounting face and nose pilot bore. Clean drive plate surface with solvent. Dry thoroughly.
2. Check engine flywheel and housing for conformance to standards SAE #3 per SAE J-927 and J-1033 tolerance specifications for pilot bore size, pilot bore runout, and mounting face flatness. Measure and record engine crankshaft end play.
3. Install two 2.50” [63.5 mm] long transmission to flywheel housing guide studs in the engine flywheel housing as shown. Rotate the engine flywheel to align a drive plate mounting screw hole with the flywheel housing access hole.
4. *Install a 4.00” [101.6 mm] long drive plate locating stud .3750-24 fine thread in a drive plate nut. Align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in Step 3.
5. Rotate the transmission torque converter to align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in Step 3. Locate transmission on flywheel housing.
6. Align drive plate to flywheel and transmission to flywheel housing guide studs. Install transmission to flywheel housing screws. Tighten screws to specified torque. Remove transmission to engine guide studs. Install remaining screws and tighten to specified torque.
7. *Remove drive plate locating stud.
8. Install drive plate attaching screw and washer. Snug screw but **do not tighten**. Some engine flywheel housings have a hole located on the flywheel housing circumference in line with the drive plate screw access hole. A screwdriver or pry bar used to hold the drive plate against the flywheel will facilitate installation of the drive plate screws. Rotate the engine flywheel and install the remaining seven (7) flywheel to drive plate attaching screws. Snug screws but **do not tighten**. After all eight (8) screws are installed, tighten each capscrew to 26-29 lbs. ft. (35-39 N•m). This will require tightening each screw and rotating the engine flywheel until the full amount of eight (8) screws have been tightened to specified torque.
9. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel. This value must be within 0.001” [0.025 mm] of the end play recorded in Step 2.

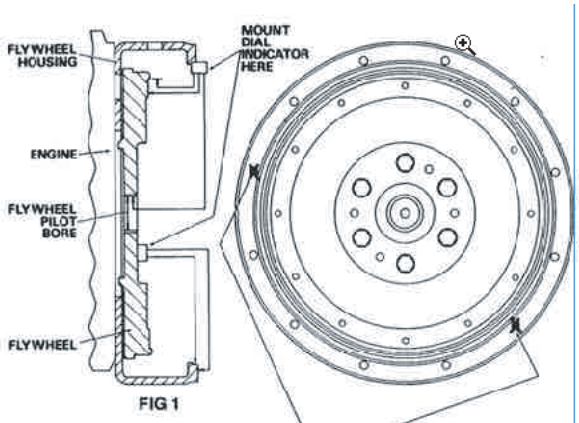


FIG 1

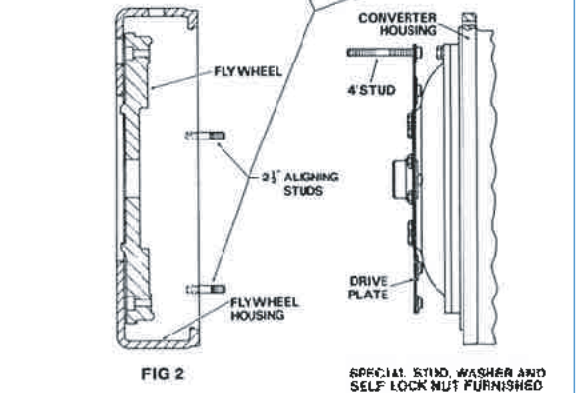


FIG 2

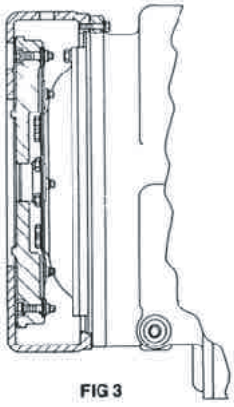
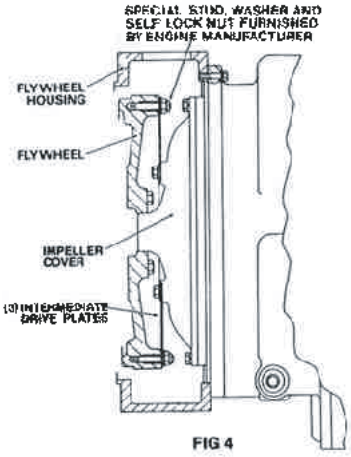


FIG 3


SPECIAL STUD, WASHER AND SELF LOCK NUT FURNISHED BY ENGINE MANUFACTURER
FLYWHEEL HOUSING
FLYWHEEL
IMPELLER COVER
(3) INTERMEDIATE DRIVE PLATES
FIG 4

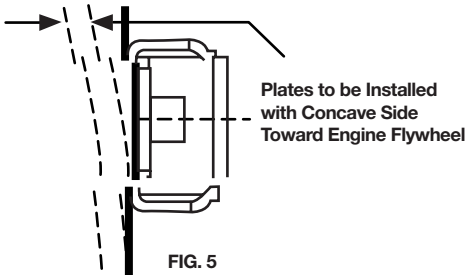


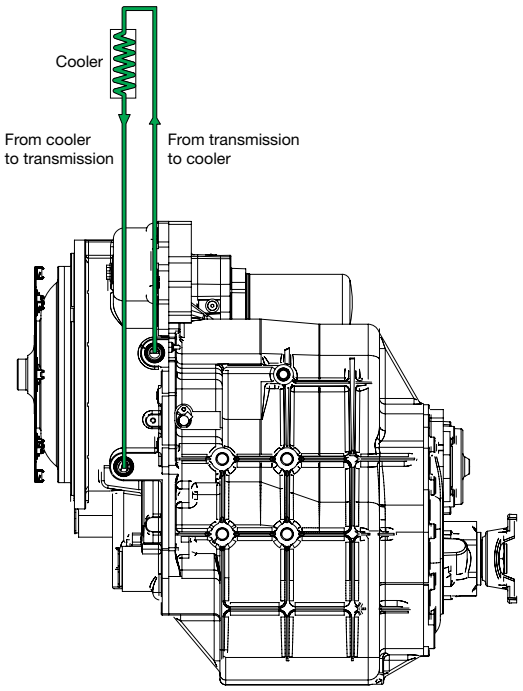
FIG. 5

* *Does not apply to units having 3 intermediate drive plates. See Figure 4.*

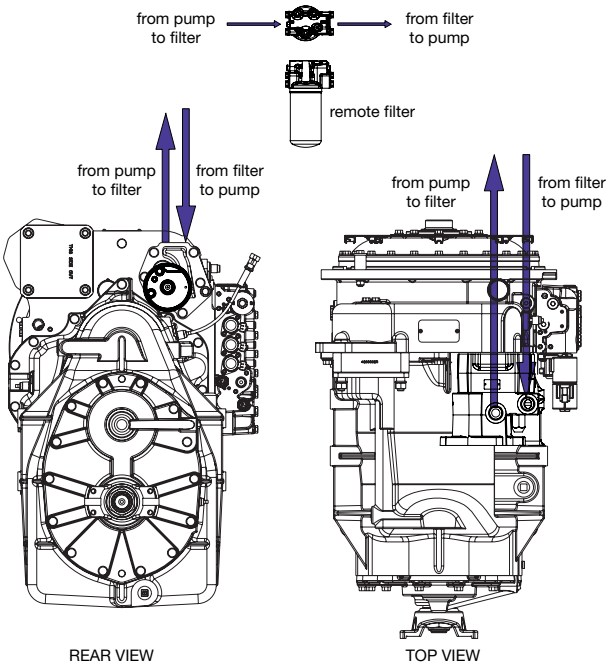
EXTERNAL PLUMBING INSTALLATION

Cooler & Filter Line Specifications

- Minimum 19 mm (.75 inch) internal diameter for lines and fittings.
- Suitable for operation from ambient to 120 °C (248 F) continuous operating temperature.
- Must withstand 30 bar (435 psi) continuous pressure and with 45 bar (652 psi) intermittent surges.
- Conform SAE J1019 and SAE J517,100RI.



Remote Filter (Optional)



SPEED SENSOR INSTALLATION

Speed Sensor Only

On the sensor body there is a small plastic triangular position sign. Make sure the position sign on the sensor points as shown below in the direction of the movement of the gear teeth (teeth rotation as shown), or 180° rotated.

The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 - 14 mA.

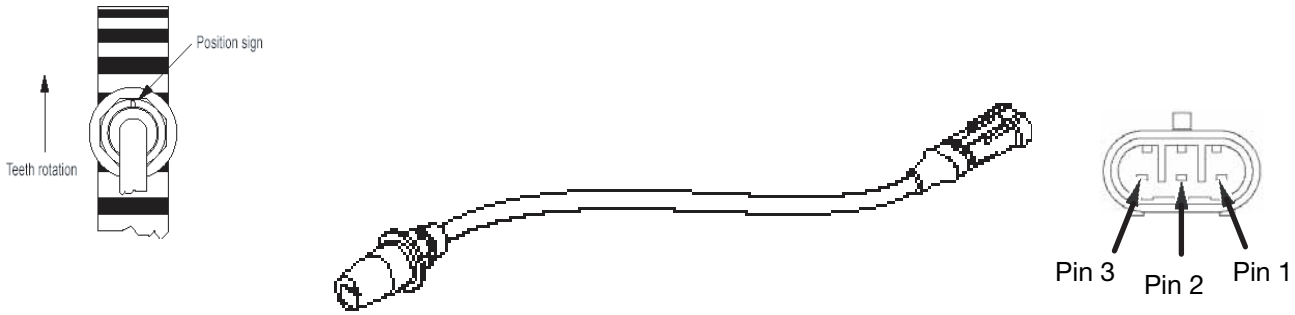
The sensor has an integrated AMP super seal 2 pin connector. The two pins are numbered 1 and 2.

Following table shows the relation between wire color, pin number, and connection.

Pin	Function	Connection
1	Current Input	Hot Wire
2	Current Output	Ground Wire

Speed Sensor & Temperature Sensor Combined

On the sensor body there is a small plastic triangular position sign. Make sure the position sign on the sensor points as shown below in the direction of the movement of the gear teeth (teeth rotation as shown), or 180° rotated.



The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 - 14 mA.

The sensor has an integrated AMP super seal 3-pin connector. The pins are numbered 1, 2, and 3.

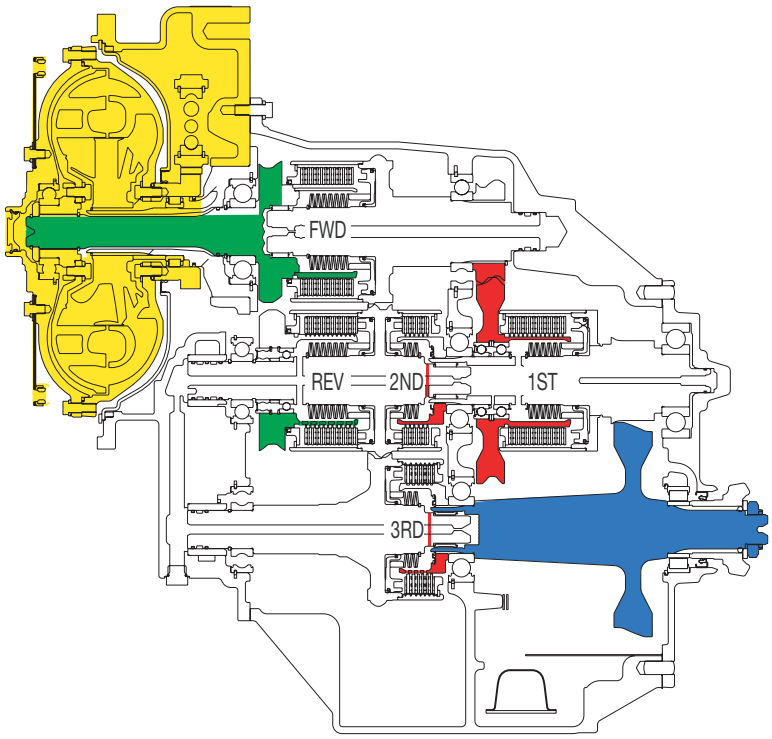
Following table shows the relation between wire color, pin number, and connection.

Pin	Function	Connection
1	Current Input	Hot Wire
2	Current Output	Ground Wire
3	Temperature Input	Hot Wire

⚠CAUTION

The sensor wires have a polarity. Be sure to correctly observe sensor polarities, as wrong connections will deactivate the sensor!

TRANSMISSION OPERATION



The transmission is composed of five main assemblies:

- Converter, pump drive section and pressure regulating valve
- Input shaft and directional clutches
- Range clutches
- Output section

Converter, Pump Drive Section, & Pressure Regulating Valve

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.

This element is the pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump, that picks up fluid at its centre and discharges it at the outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the turbine shaft of the torque converter. This element receives fluid at its outer diameter and discharges it at its centre.

The reaction member of the torque converter is located between and at the centre of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element. This recirculation will make the converter to multiply torque.

The torque multiplication is function of the blading (impeller, turbine and reaction member) and the converter output speed (turbine speed). The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).

Therefore we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing.

The hydraulic pump is connected with the pump drive gear. This pump drive gear is driven by the impeller hub gear. Since the impeller hub gear is connected with the impeller cover, the pump speed is in direct relation with the engine speed.

Input Shaft & Directional Clutches

The turbine shaft driven from the turbine transmits power to the forward or reverse clutch.

These clutches consist of a drum with internal splines and a bore to receive a hydraulic actuated piston. The piston is oil tight by the use of sealing rings. The steel discs with external splines, and friction discs with internal splines, are alternated until the required total is achieved.

A back-up plate is then inserted and secured with a retainer ring. A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.

To engage the clutch, the current on the electronic controlled modulation solenoids should go from 1000 mA to 0 mA in order to change the pressure to the clutch from 0 to maximum pressure via a modulated way. The oil under pressure will go through tubes and passages to the selected clutch shafts.

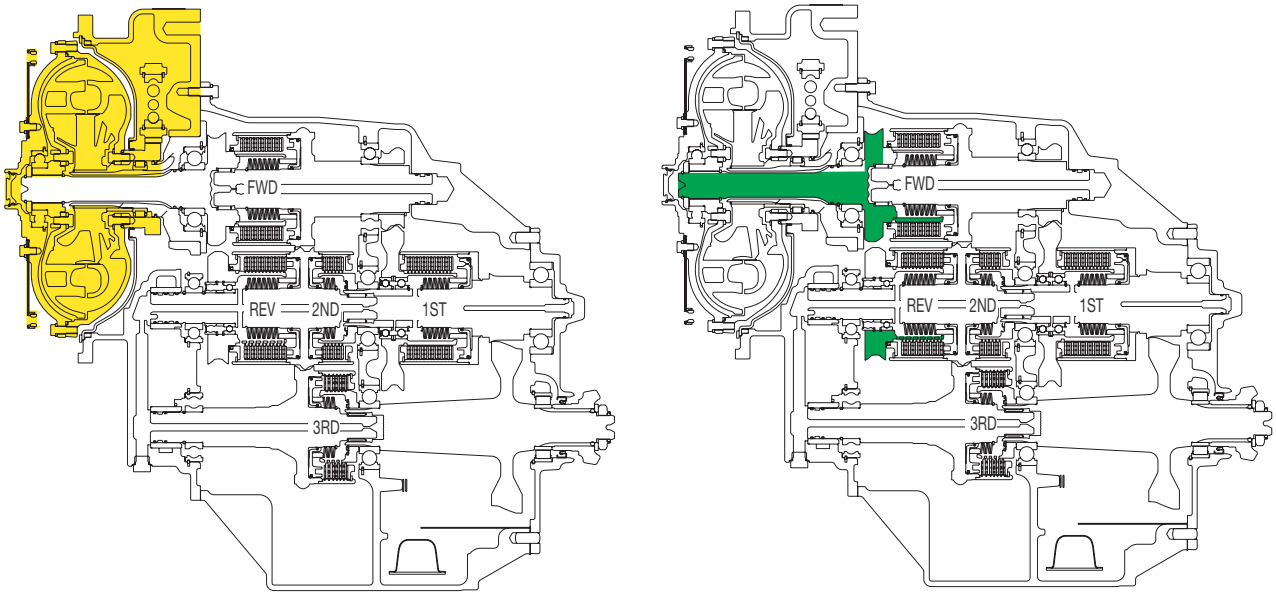
This means that clutch pressure is built up gradually. This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive.

Oil sealing rings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.

Pressure of the oil forces the piston and discs against the back-up plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.

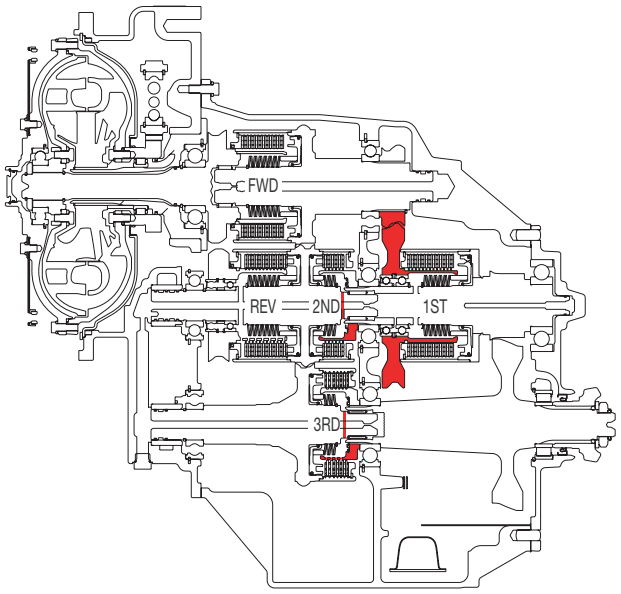
When the clutch is released, a return spring will push the piston back and oil will drain back via the shift spool, the bleed valve or holes in the clutch piston into the transmission sump.

These bleed valves will only allow quick escape of oil when the pressure to the piston is released.



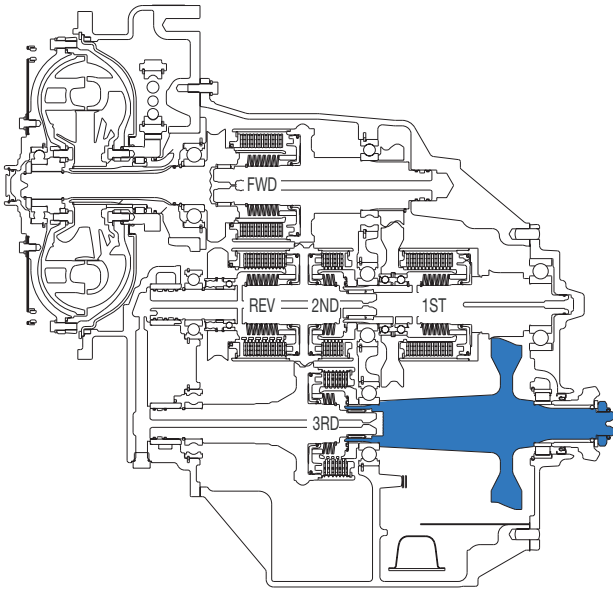
Range Clutches

Once a directional clutch is engaged power is transmitted to the range clutches (1st, 2nd or 3rd).Operation and actuation of the range clutches is similar to the directional clutches.



Output Section

With a range clutch engaged, power is finally transmitted to the output shaft.Output rotation is same as the input rotation when the forward clutch is engaged.



Transmission Controls

The transmission is controlled by the control valve (refer to hydraulic diagrams for additional information). The control valve assembly is mounted directly on the side of the converter housing. The function of the control valve assembly is to direct oil under pressure to the desired directional and speed clutches.

Operation of the Valve

Regulated pressure 319-377 PSI [22-26 bar] is directed to the proportional valve and selector valves to activate the required clutches.

When activated the proportional valve will give an output pressure curve from 0-377 PSI [0-26 bar] proportional to a current from 0 mA to 1000 mA. Dampers are used to dampen any hydraulic vibration.

Directional Selection

When a direction (forward or reverse) is selected, the required selector valve is activated for forward or reverse and the proportional valve will provide a pressure rise from 0 to 26 bar feeding the directional clutch with modulated pressure.

Range Selection

When 1st clutch is selected, the 1st/3rd selector valve is activated and the 1st/3rd proportional valve will provide a pressure rise from 0 to 26 bar feeding the 1st clutch with modulated pressure.

When 2nd clutch is selected, the 1st/3rd proportional valve will decrease pressure from 26 to 0 bar, thus releasing the 1st clutch in a controlled manner. At the same time, the 2nd proportional valve is activated and will provide a pressure curve from 0 to 26 bar, which will provide clutch overlap. When the shift is finalized, the 1st/3rd selector valve is deactivated.

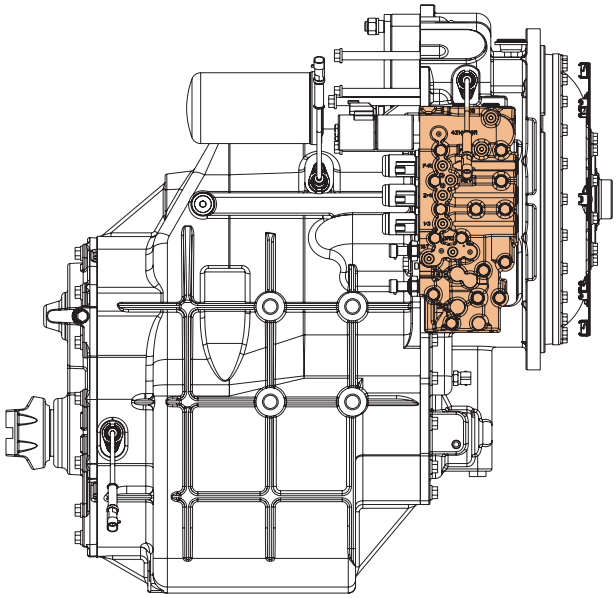
When 3rd clutch is selected, the 1st/3rd selector valve is not activated. The 2nd proportional valve will decrease pressure from 26 to 0 bar, thus releasing the 2nd clutch in a controlled manner. At the same time the 1st/3rd proportional valve is activated and will provide a pressure curve from 0 to 26 bar, which will provide clutch overlap.

Restriction Plug

The pressure line is connected to the drain line via a restricted hole. This ensures the drain line remains air free at all times and guarantees reliable operation of the proportional valves.

Pressure Sensor

The control valve also has a pressure sensor installed to monitor overlap on range clutches.

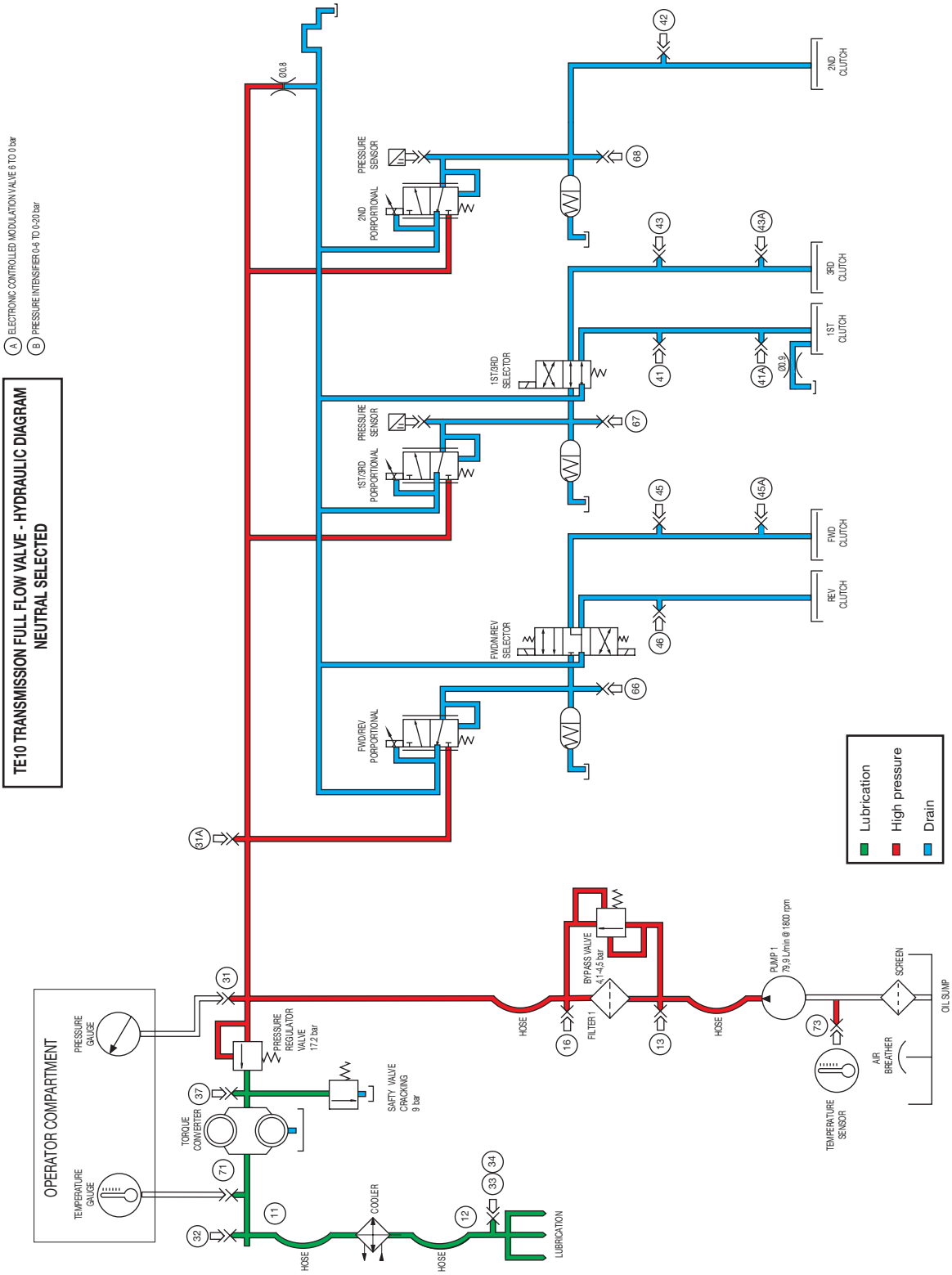


Electric Solenoid Controls

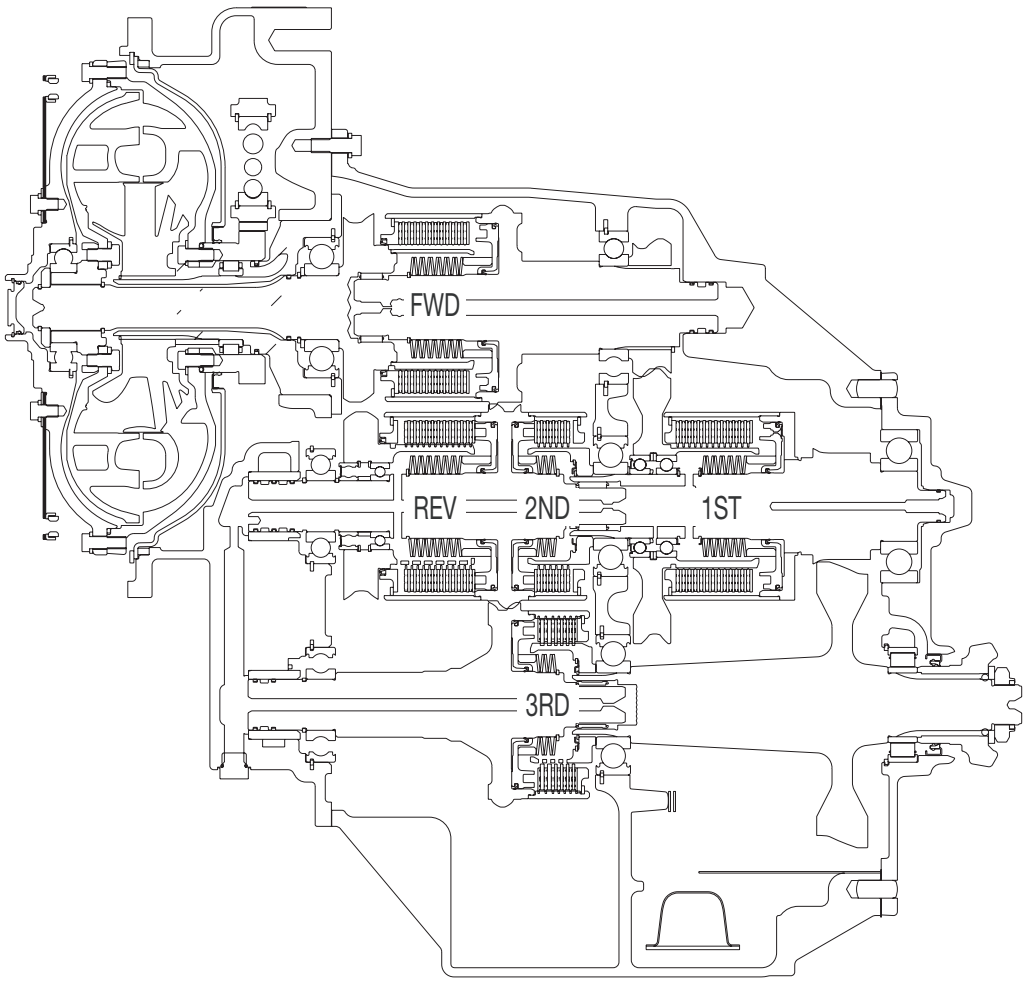
Transmission Gear	Activated Selector Valve	Activated Proportional Valve	Activated Clutches
Forward 3	FWD	FWD/REV, 1st/3rd	Forward, 3rd
Forward 2	FWD, 2nd	FWD/REV, 2nd	Forward, 2nd
Forward 1	FWD, 1st/3rd	FWD/REV, 1st/3rd	Forward, 1st
Neutral 3		1st/3rd	3rd
Neutral 2	2nd	2nd	2nd
Neutral 1	1st/3rd	1st/3rd	1st
Reverse 3	REV	FWD/REV, 1st/3rd	Reverse, 3rd
Reverse 2	REV, 2nd	FWD/REV, 2nd	Reverse, 2nd
Reverse 1	REV, 1st/3rd	FWD/REV, 1st/3rd	Reverse, 1st

Power Flows, Activated Solenoids, & Hydraulic Circuits

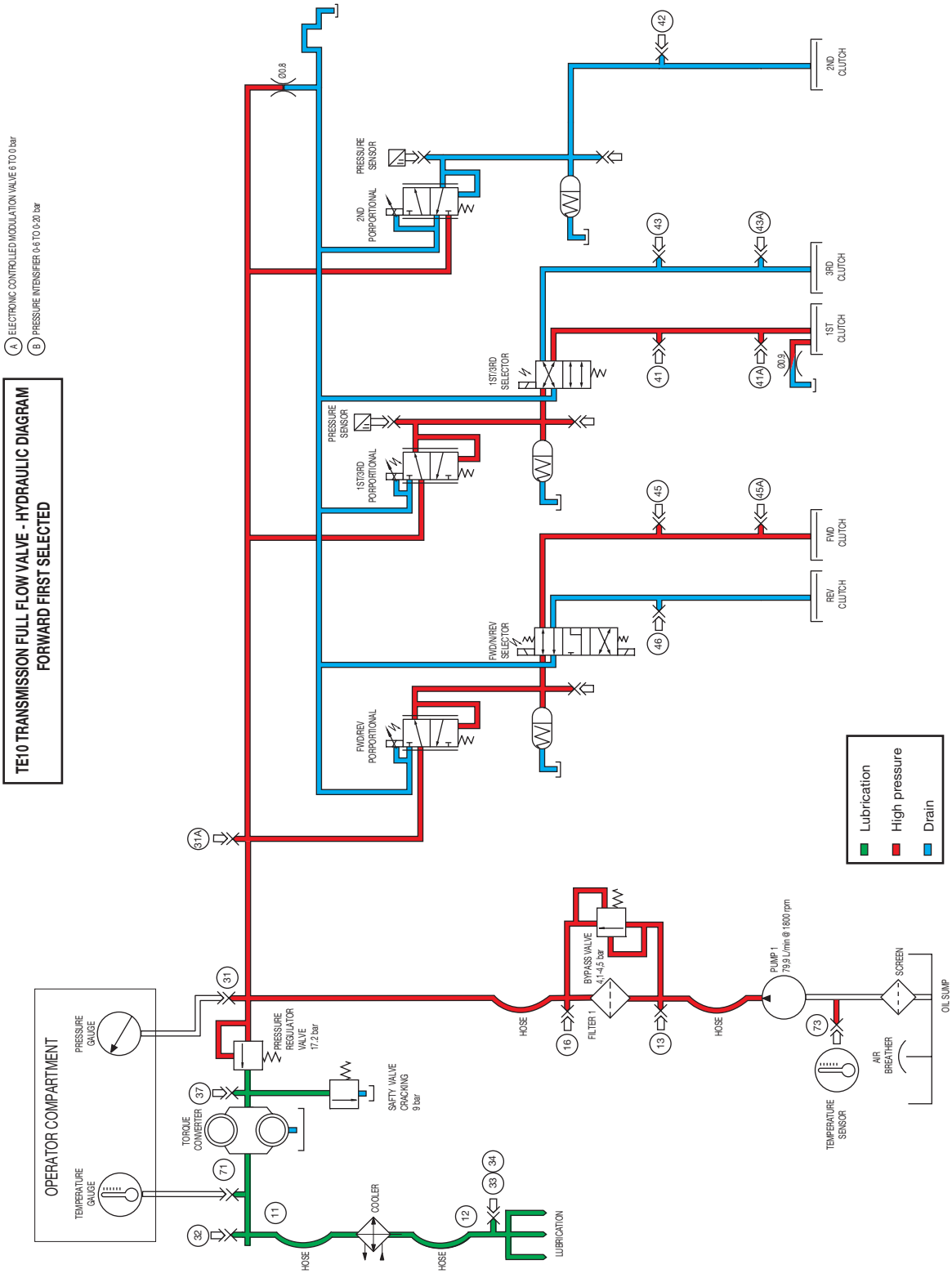
Neutral Selected



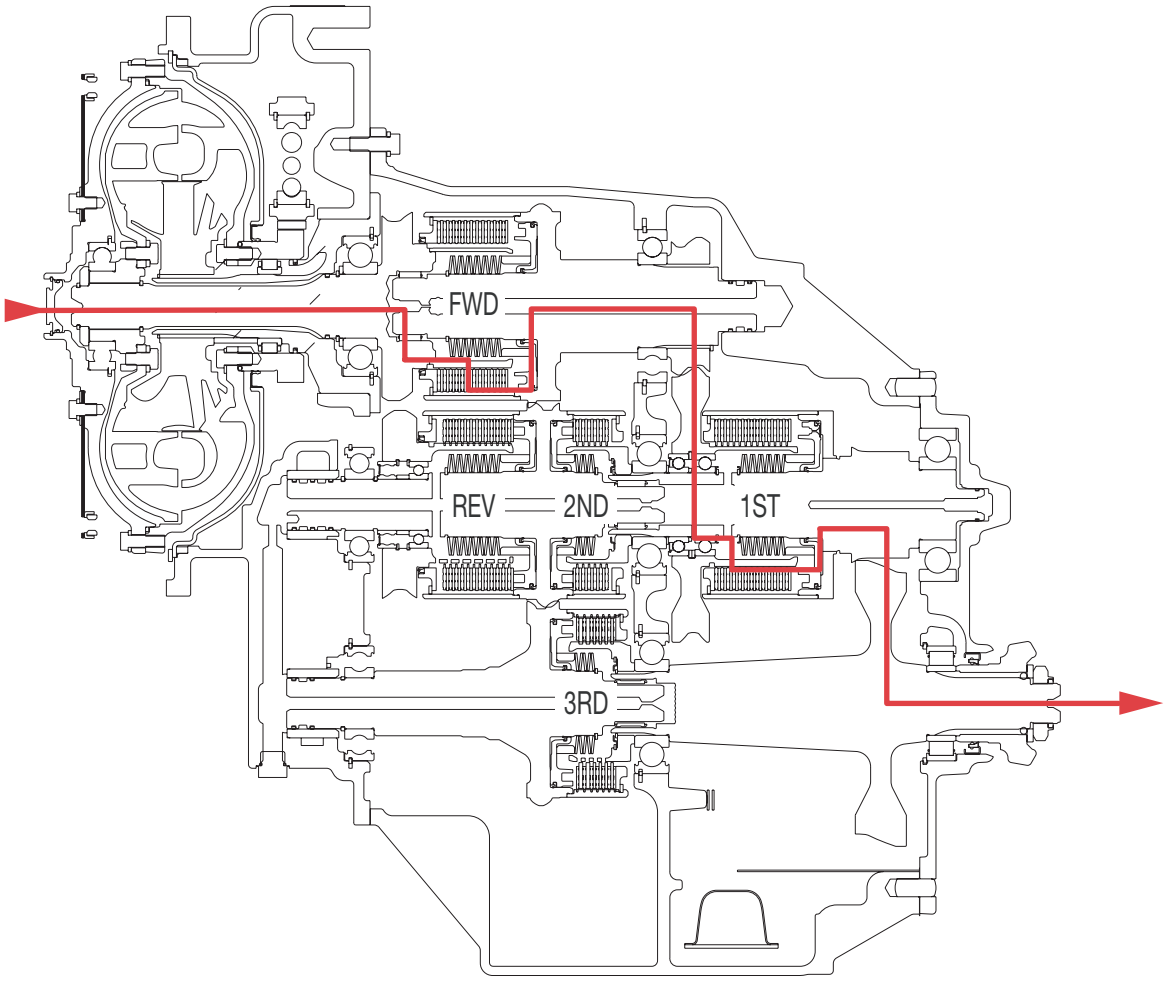
Neutral (Continued)



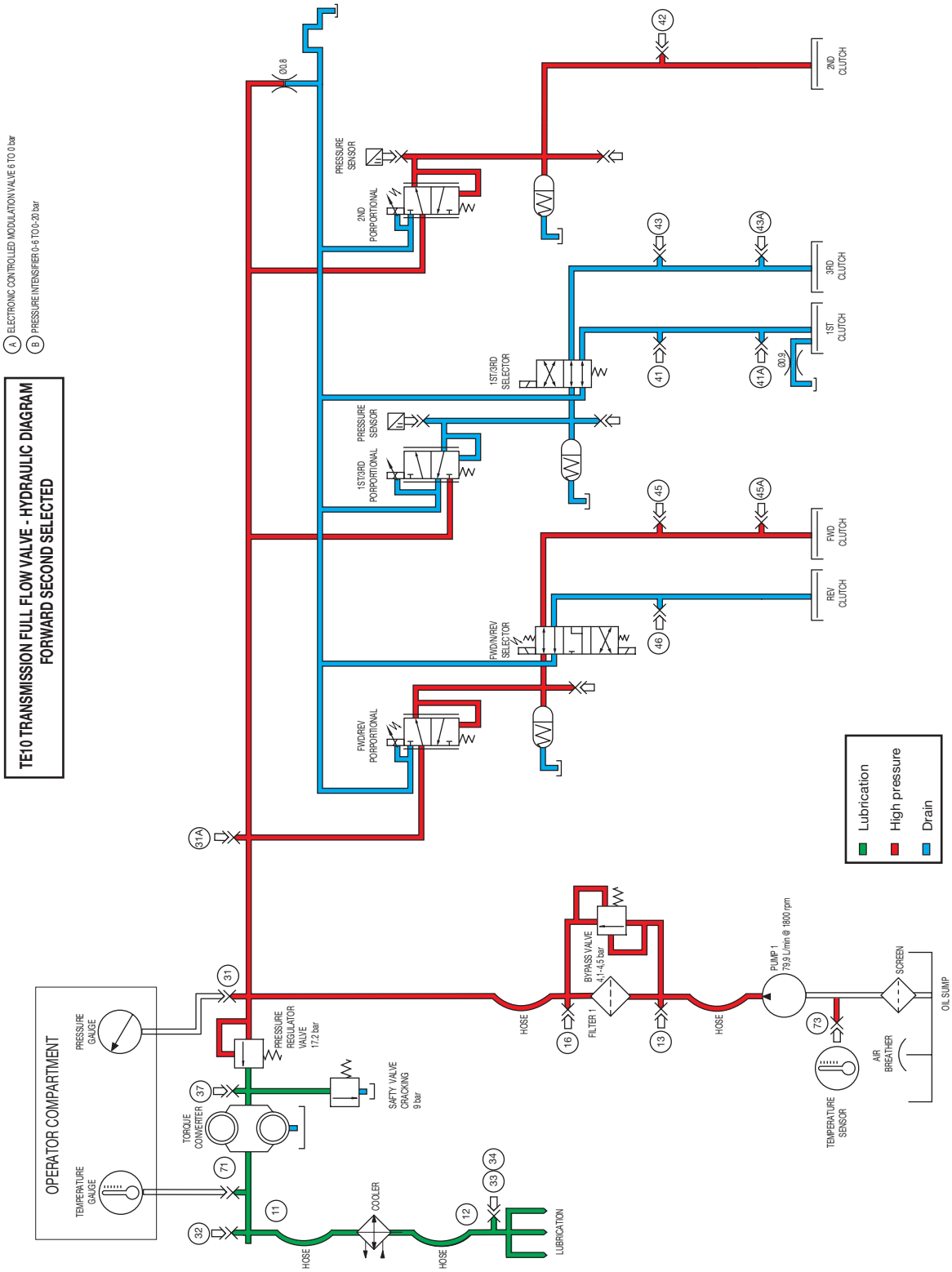
Forward 1st Speed



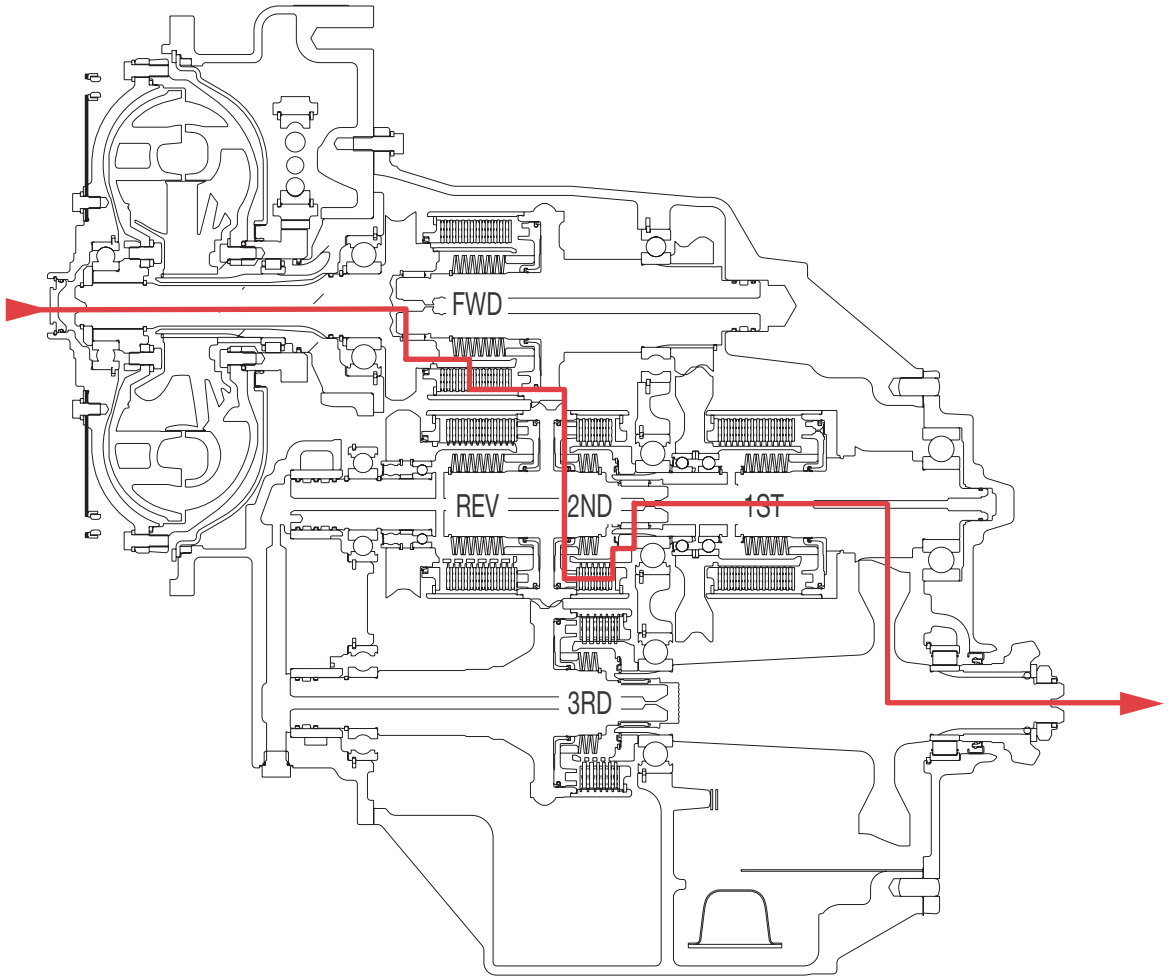
Forward 1st Speed (Continued)



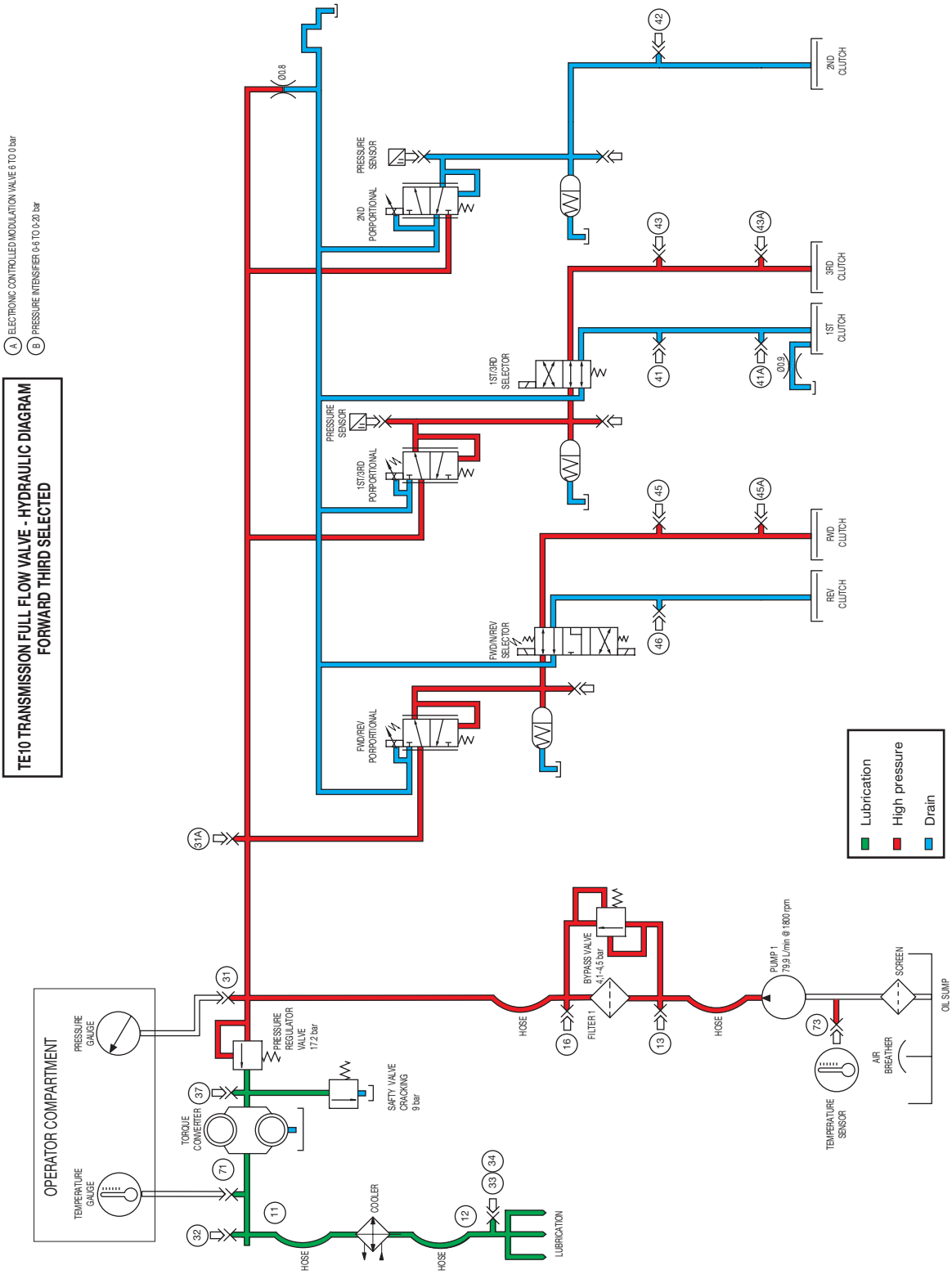
Forward 2nd Speed



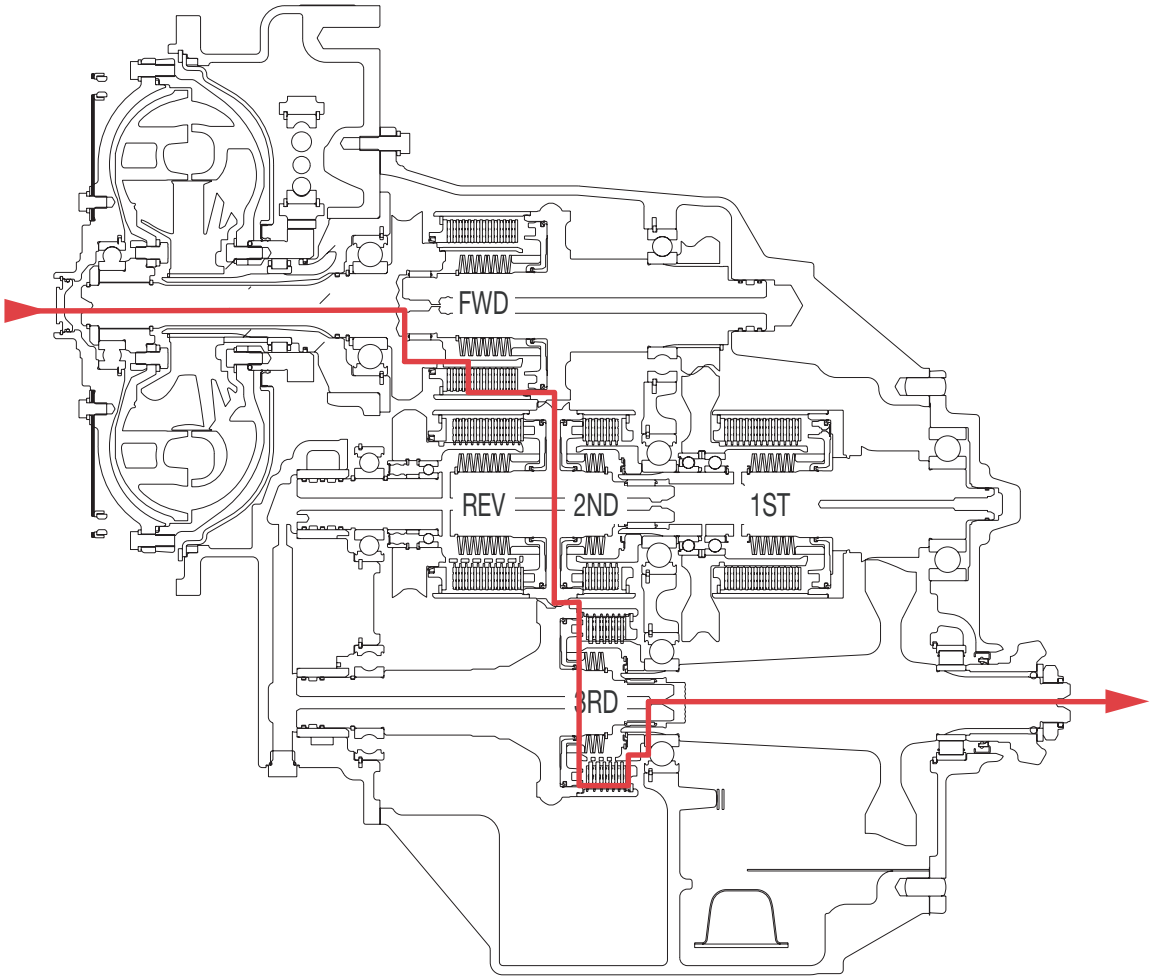
Forward 2nd Speed (Continued)



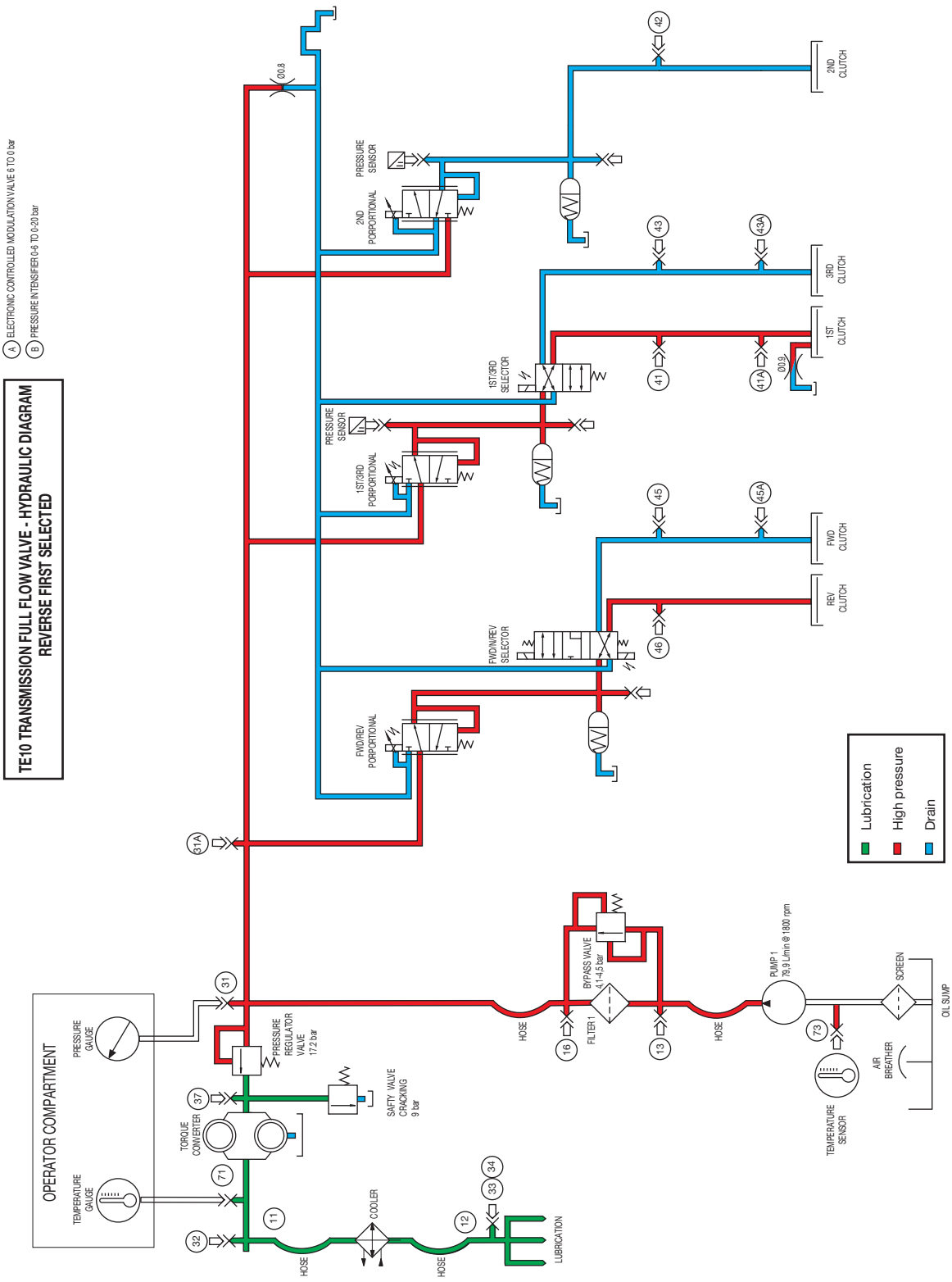
Forward 3rd Speed



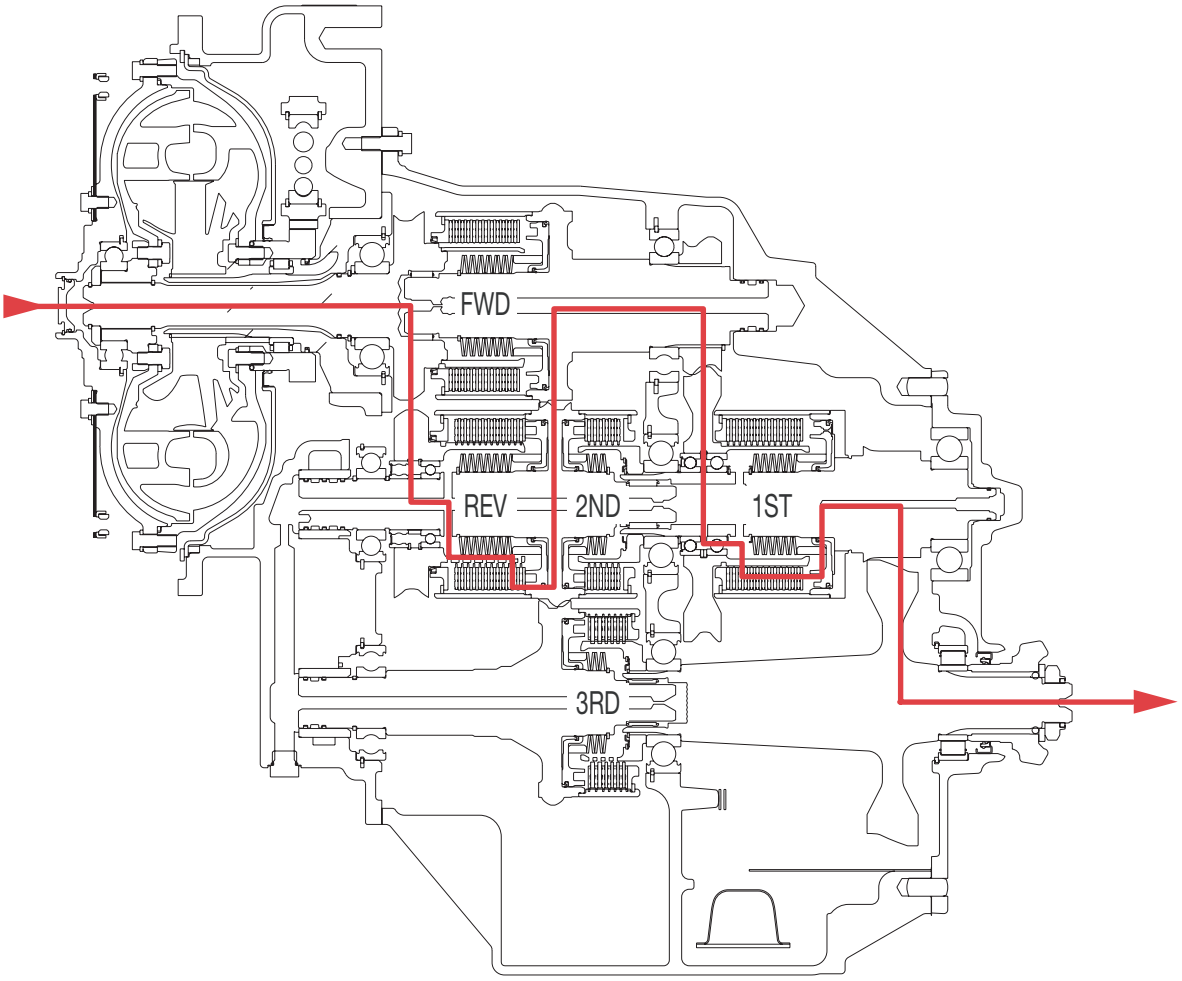
Forward 3rd Speed (Continued)



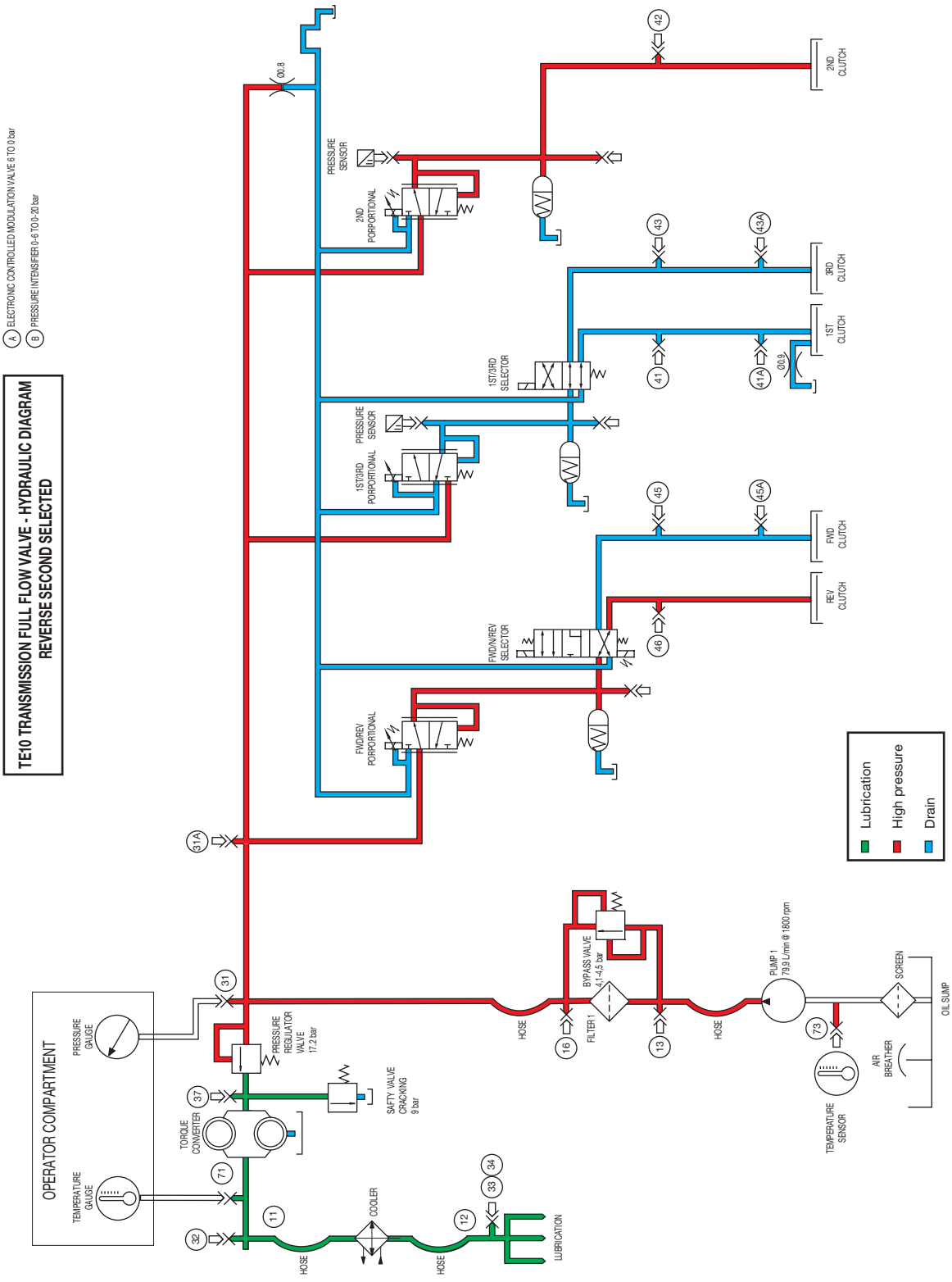
Reverse 1st Speed



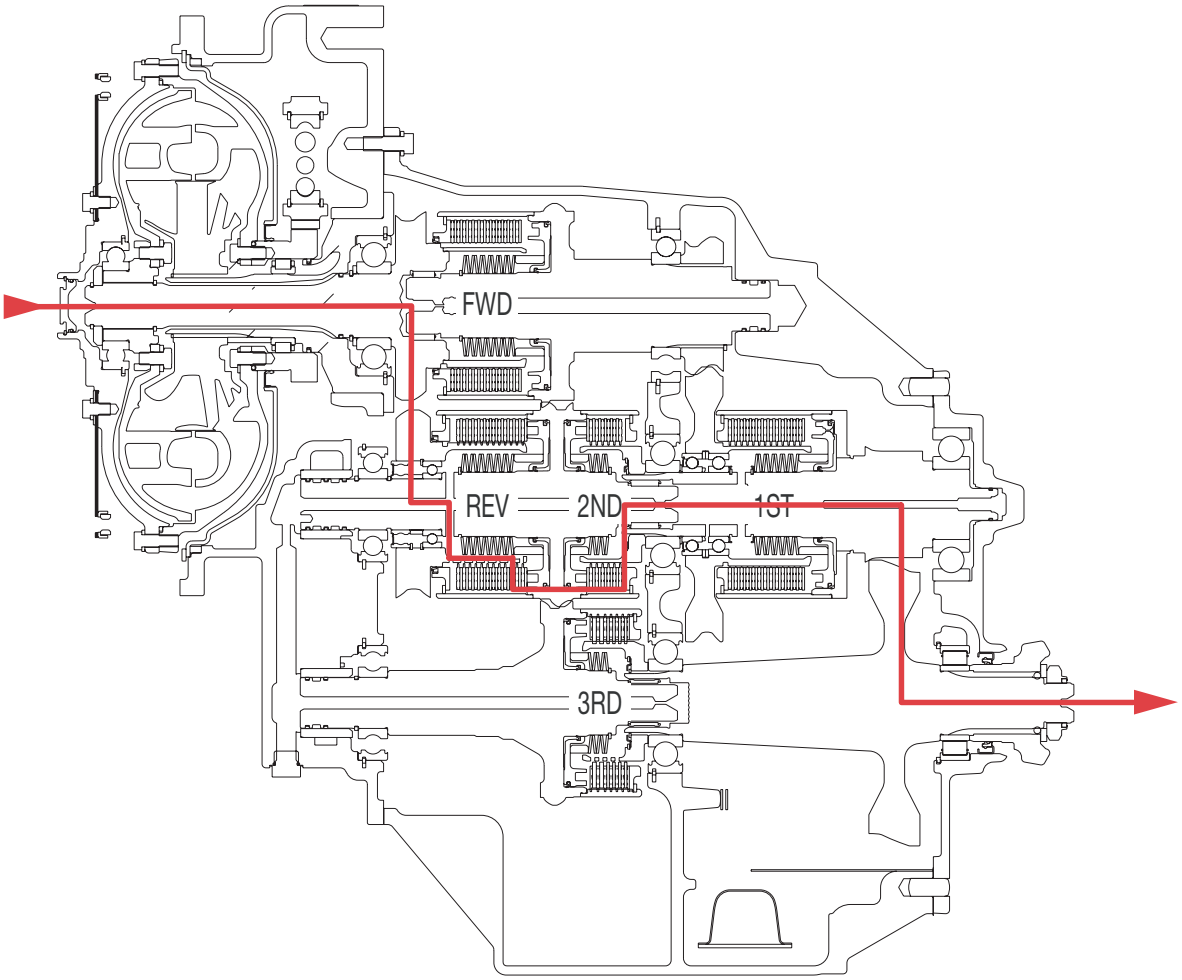
Reverse 1st Speed (Continued)



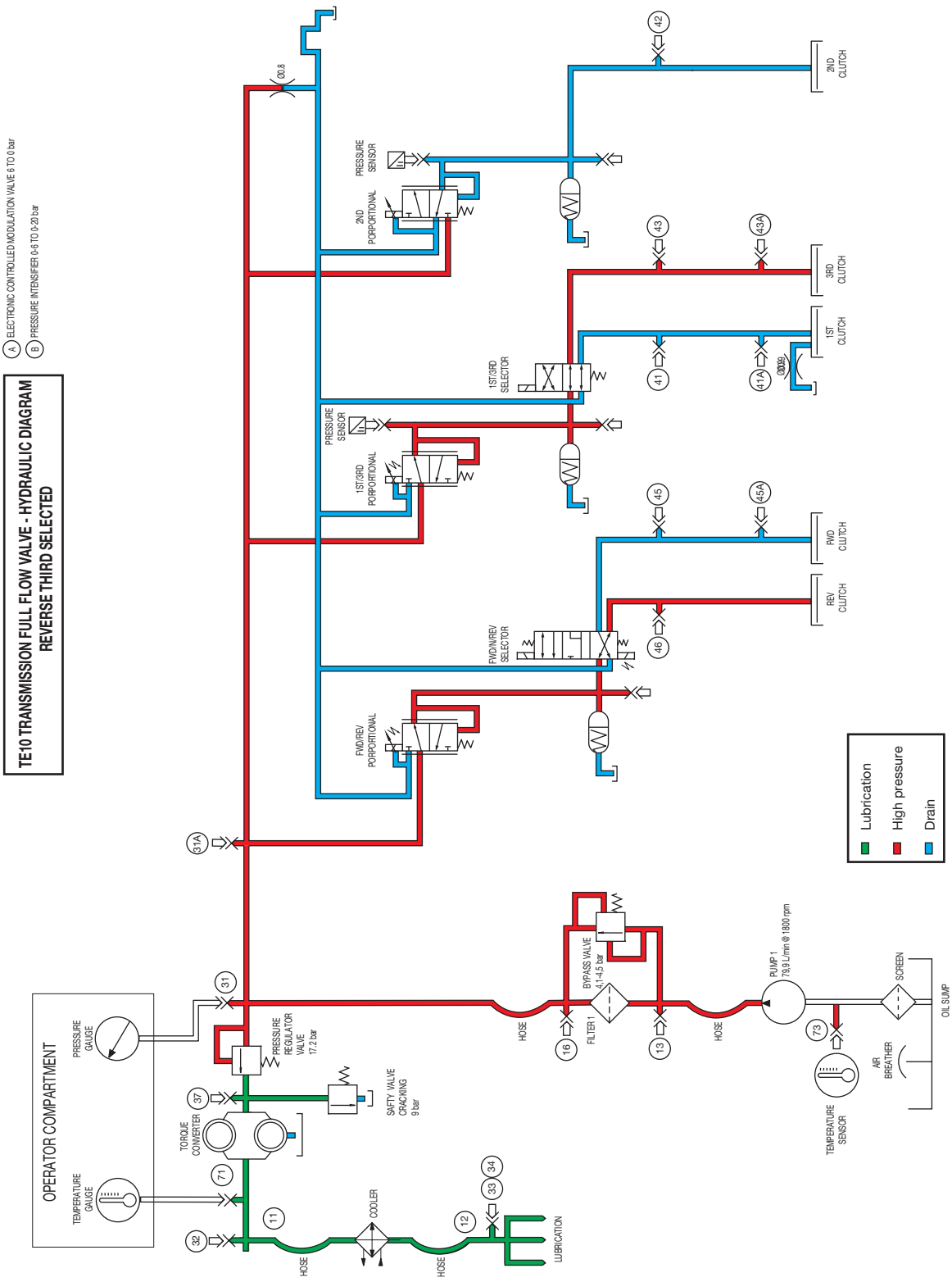
Reverse 2nd Speed



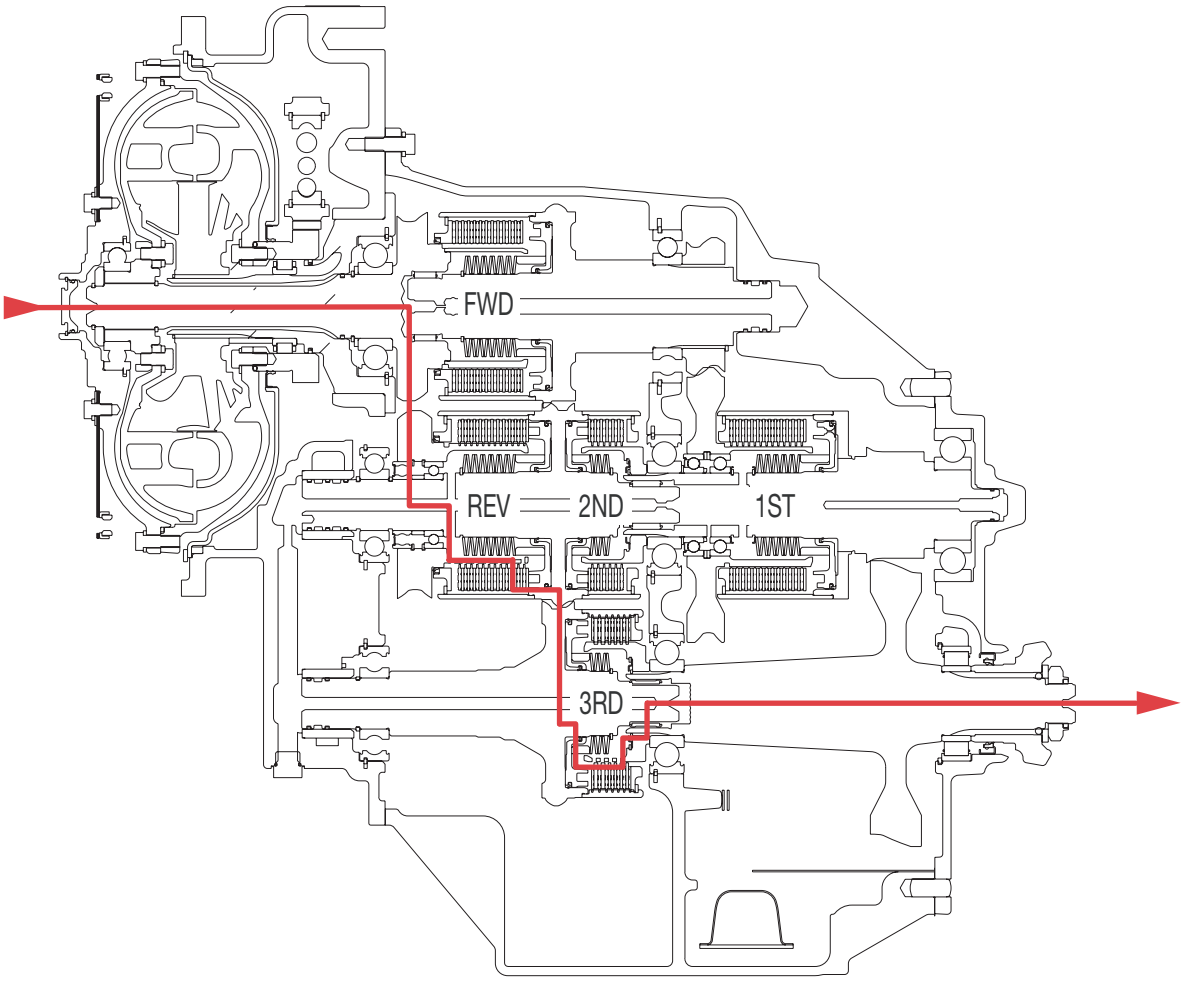
Reverse 2nd Speed (Continued)



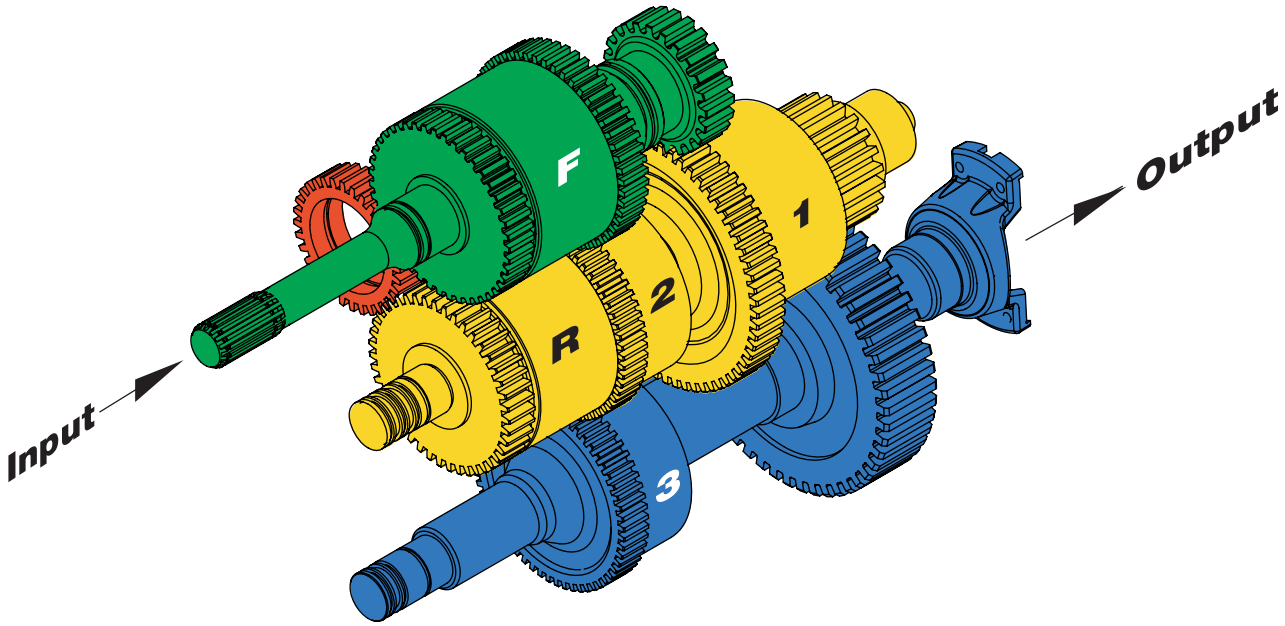
Reverse 3rd Speed



Reverse 3rd Speed (Continued)



Gear & Clutch Layout



TROUBLESHOOTING

The following information is presented as an aid to isolate and determine the specific problem areas in a transmission that is not functioning correctly.

When troubleshooting a “transmission” problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, torque converter, transmission assembly, oil cooler, filter, connecting lines, and controls, including the engine, as a complete system.

By analyzing the principles of operation together with the information in this section, it should be possible to identify and correct any malfunction which may occur in the system.

TE10 Transmission

TE10 (power shift with torque converter transmission) troubles fall into four general categories:

1. Mechanical problems.
2. Hydraulic problems.
3. Electrical problems.
4. Controller problems

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the “life blood” of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to ensure converter operation, to engage and hold the clutches from slipping, and to cool and lubricate the working components.

Troubleshooting Procedures

Stall Test

A stall test to identifies transmission, converter, or engine problems.

Use following procedure:

1. Put the vehicle against a solid barrier, such as a wall, and/or apply the parking brake and block the wheels.
2. Put the directional control lever in FORWARD (or REVERSE, as applicable).
3. Select the highest speed in manual modeWith the engine running, slowly increase engine speed to approximately one-half throttle and hold until transmission (converter outlet) oil temperature reaches the operating range.

⚠CAUTION

Do not operate the converter at stall condition longer than 30 seconds at one time, shift to neutral for 15 seconds and repeat the procedure until desired temperature is reached. Excessive temperature 120 °C (250 F) maximum will cause damage to transmission clutches, fluid, converter, and seals.

Transmission Pressure Checks

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.

In addition, converter charging pressure and transmission lubrication pressure can also be measured.

Mechanical and Electrical Checks

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake and inching pedal for correct adjustment.
- Be sure all lever linkage is properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure that all components of the cooling system are in good condition and operating correctly. The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.
- The engine must be operating correctly. Be sure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

Hydraulic Checks

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:

Check oil level in the transmission. The transmission fluid must be at the correct (full level). All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times.

NOTE:

The transmission fluid must be at operating temperature of 82 - 93 °C (180 - 200 F) to obtain correct fluid level and pressure readings. NEVER attempt to make these checks with cold oil.

To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with the converter at “stall” (see “Stall Test”, on page 36).

⚠CAUTION

Be careful the vehicle does not move unexpectedly when operating the engine and converter at stall rpm.

Troubleshooting Guide

Refer to the following troubleshooting guide for the diagnosis of typical transmission troubles.

Low Clutch Pressure

Cause	Remedy
Low oil level	Fill to proper level
Clutch pressure regulating valve stuck open	Clean valve spool and housing
Faulty charging pump	Replace pump
Broken or worn clutch shaft or piston sealing rings	Replace sealing rings
Clutch piston bleed valve stuck open	Clean bleed valves thoroughly

Low Charging Pump Output

Cause	Remedy
Low oil level	Fill to proper level
Suction screen plugged	Clean suction pump
Defective charging pump	Replace pump

Overheating

Cause	Remedy
Worn oil sealing rings	Remove, disassemble, & rebuild converter assembly
Worn charging pump	Replace charging pump
Low oil level	Fill to proper level
Dirty oil cooler	Clean cooler
Restriction in cooler lines	Change cooler lines

Noisy Converter

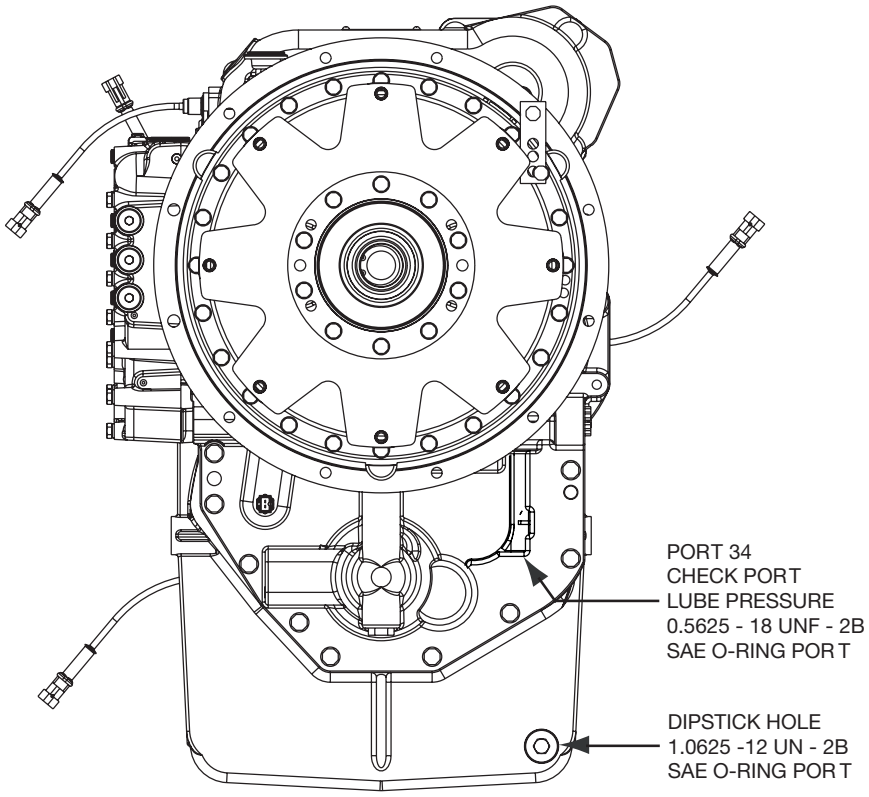
Cause	Remedy
Worn charging pump	Replace charging pump
Worn or damaged bearings	A complete disassembly will be necessary to determine which bearing is faulty
Defective charging pump	Replace pump

Lack of Power

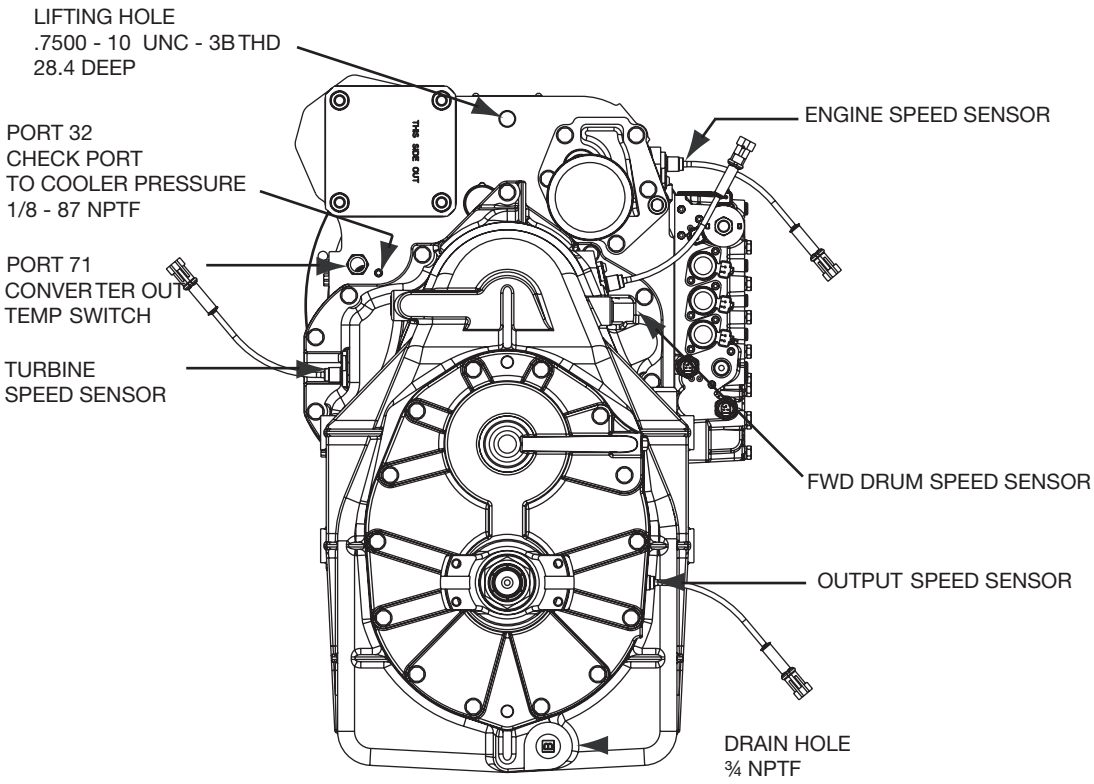
Cause	Remedy
Low engine RPM at converter stall	Tune engine check governor
See “Overheating” section above and make same checks	Make corrections as explained in “Overheating”

Check Points

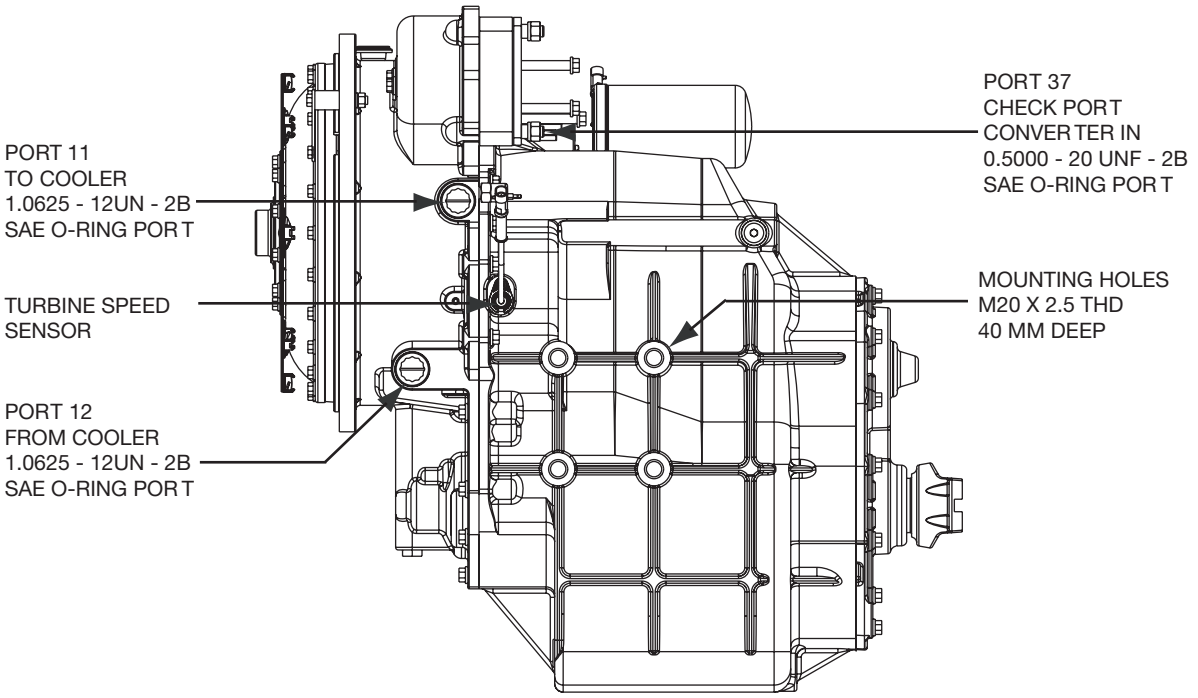
Front View



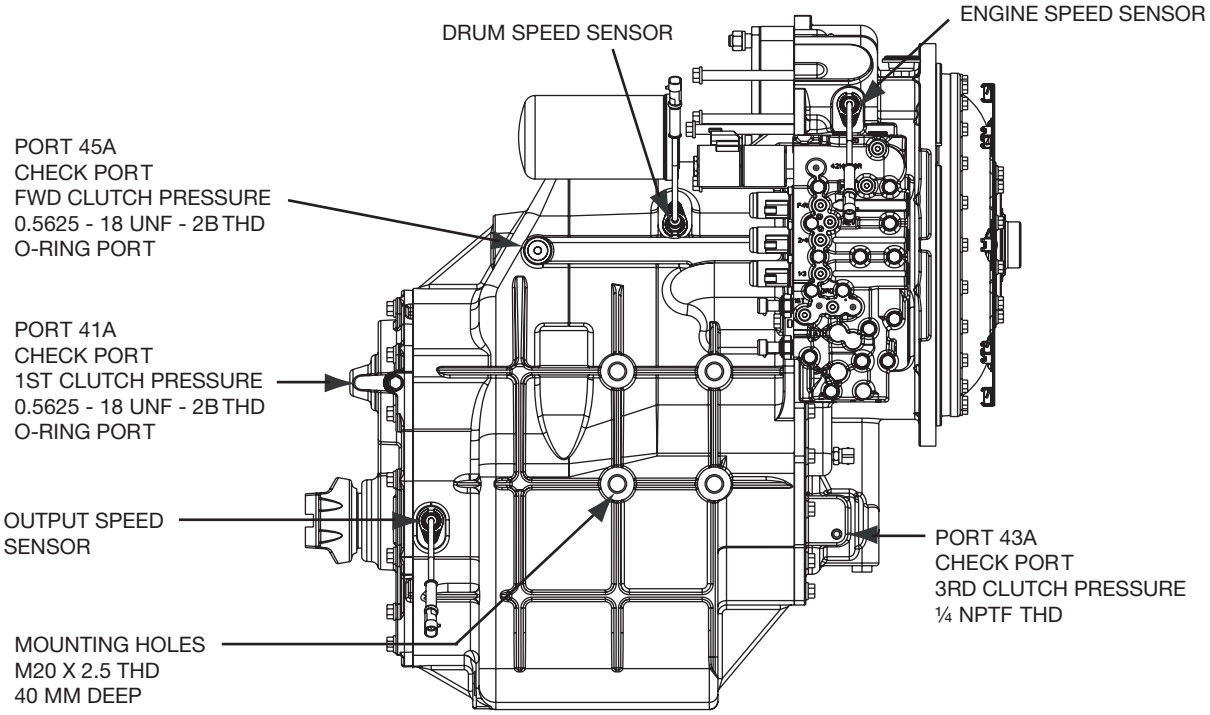
Rear View



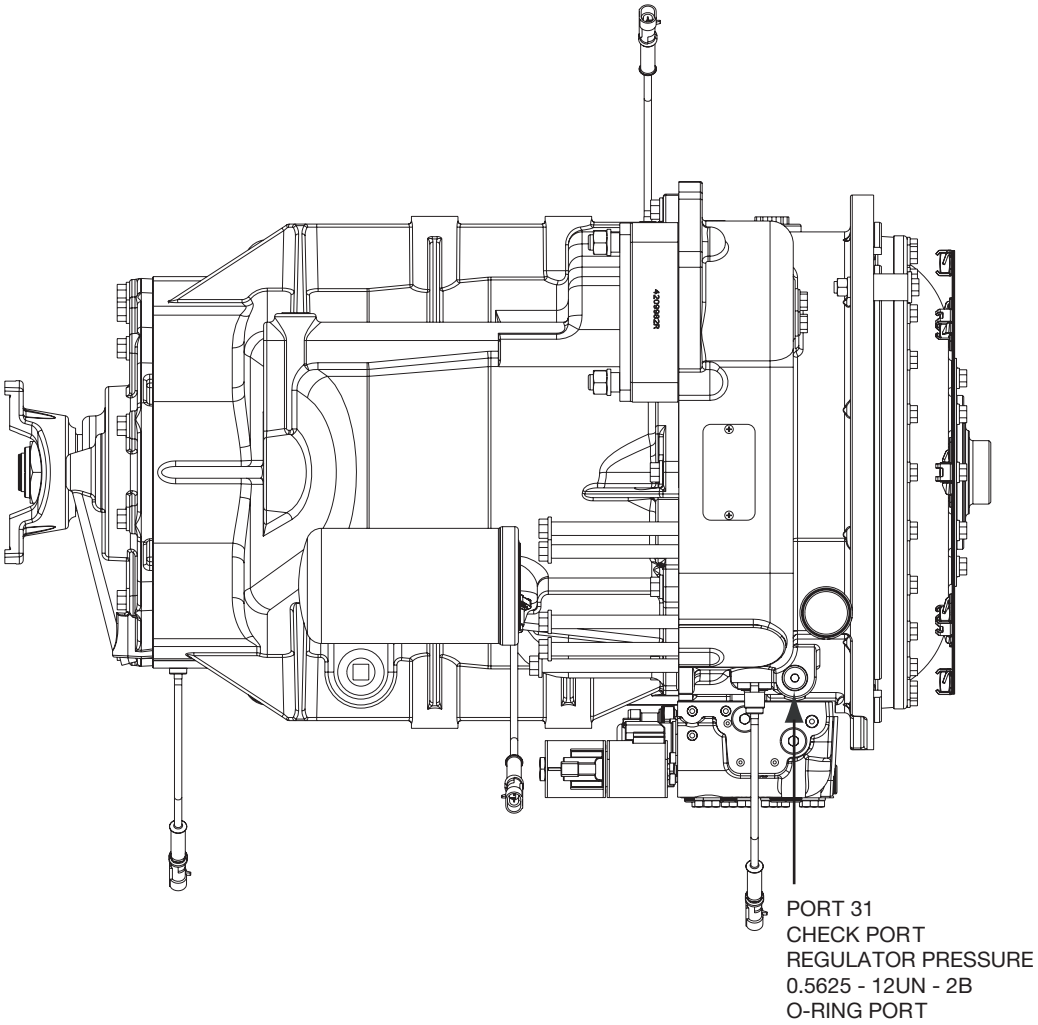
Left View



Right View

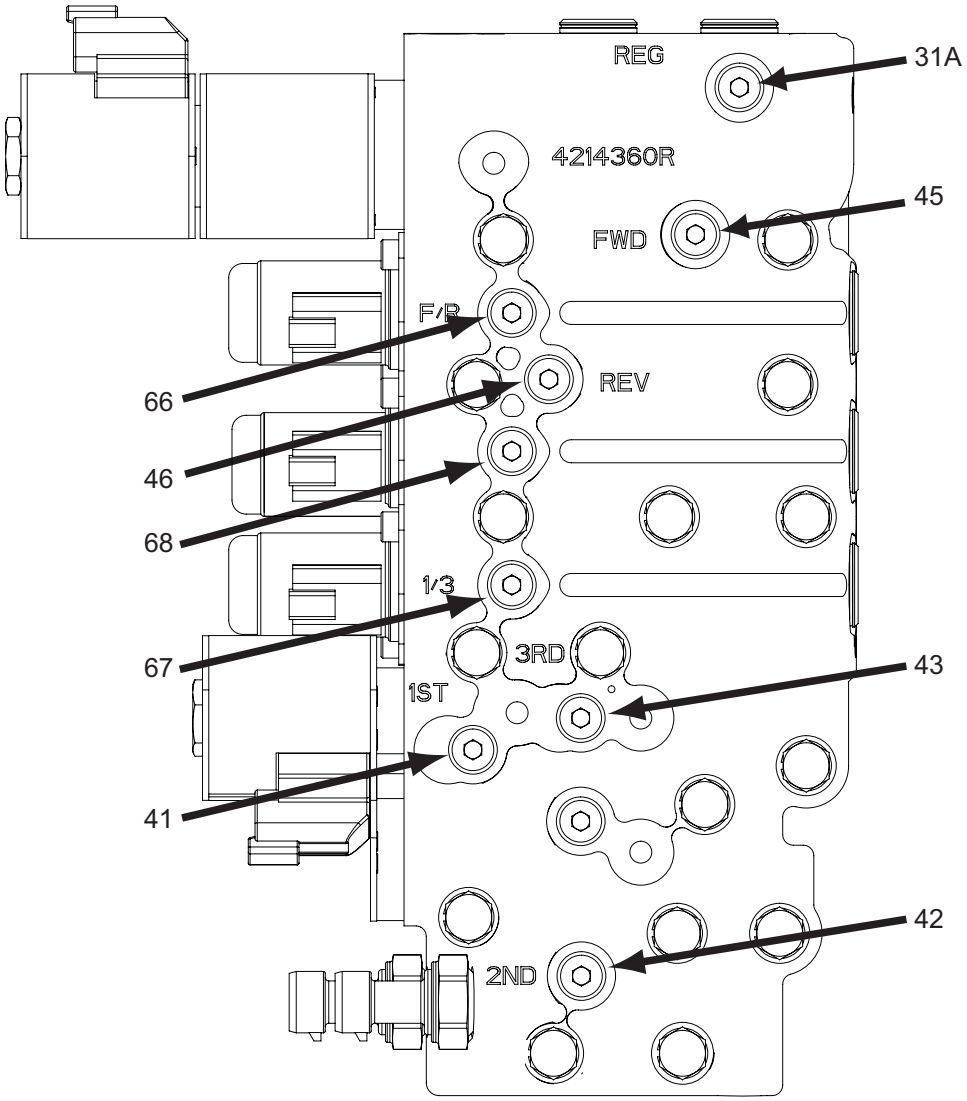


Top View

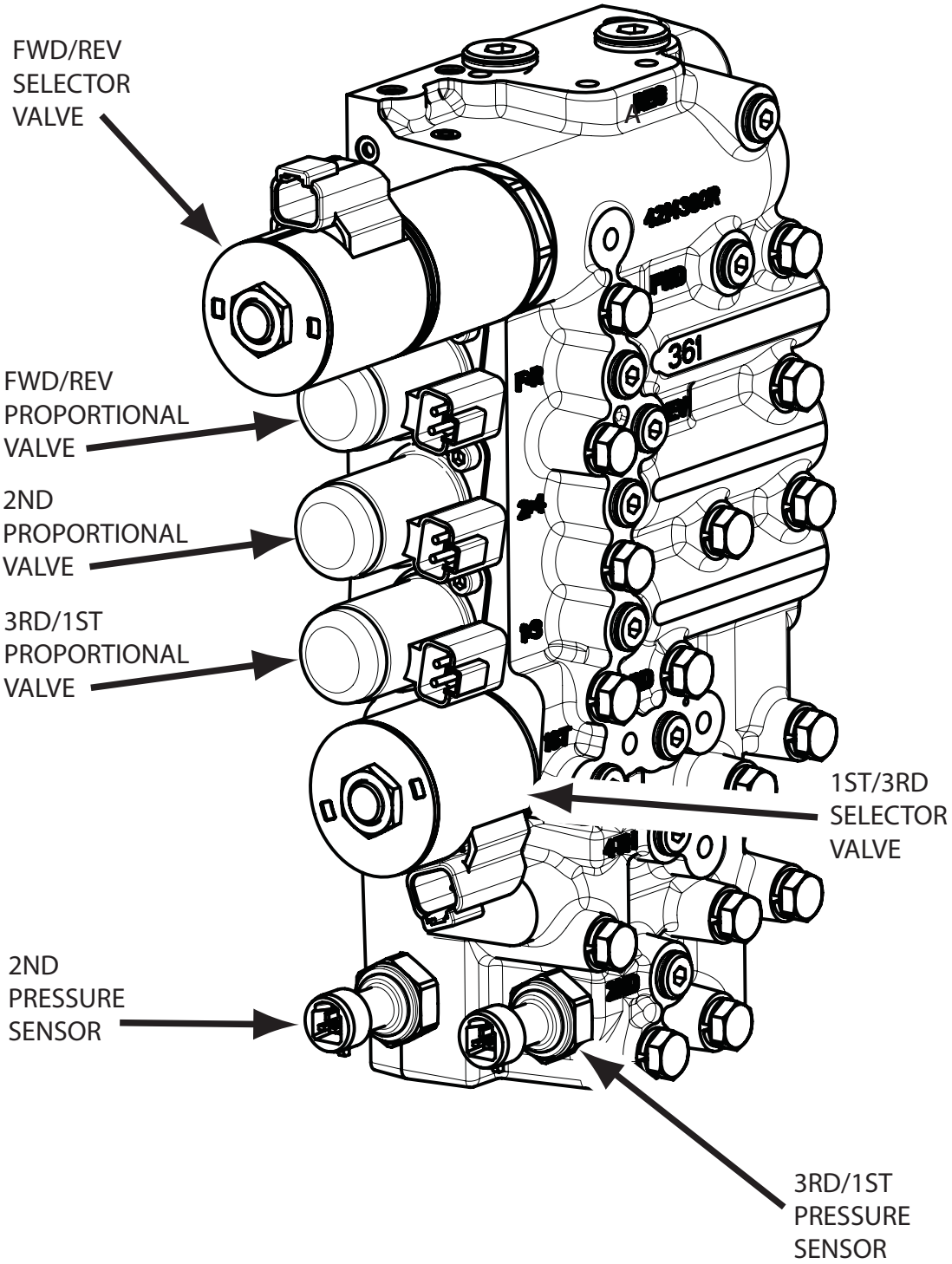

PORT 31
CHECK PORT
REGULATOR PRESSURE
0.5625 - 12UN - 2B
O-RING PORT

Checkports

31A	System Pressure
41	1st Clutch Pressure
42	2nd Clutch Pressure
43	3rd Clutch Pressure
45	FWD Clutch Pressure
46	REV Clutch Pressure
66	FWD/REV Regulated Pressure
67	1st / 3rd Regulated Pressure
68	2nd Regulated Pressure



Full Flow Valve Components



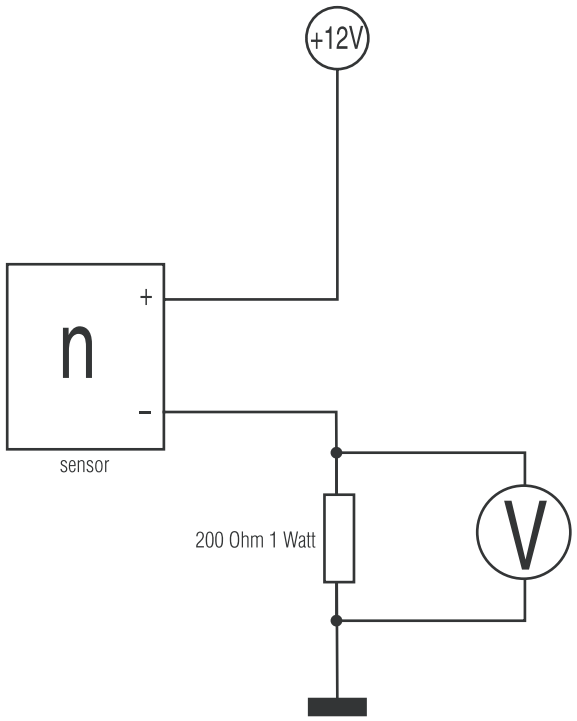
Speed Sensor - Static Standalone Test

In order to be able to sense the currents, a series resistor of e.g. 200 W must be used. This resistor is integrated in the controller, but when the sensor is to be tested, it must be connected externally.

The idea is to connect the sensor to an external power source and measure the DC voltage across the series resistor.

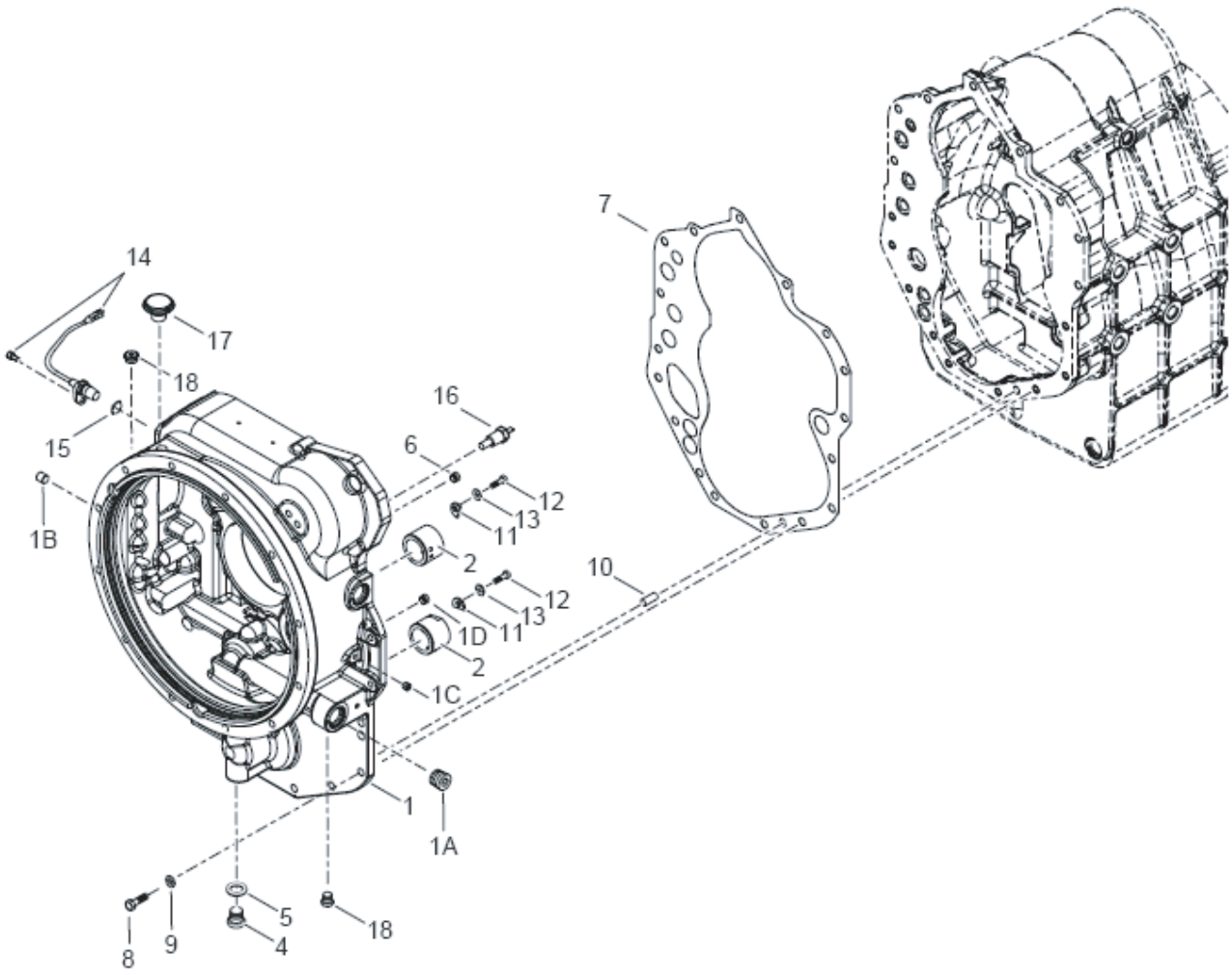
The voltage reading should be either 1.2V-1.6V (for the 7mA ± 1mA current level) or 2.6-3.0V (for the 14mA ± 1mA current level)

If the teeth can be moved slowly, distinct toggling between the two levels should be noticed.



EXPLODED VIEWS

Converter Housing Group

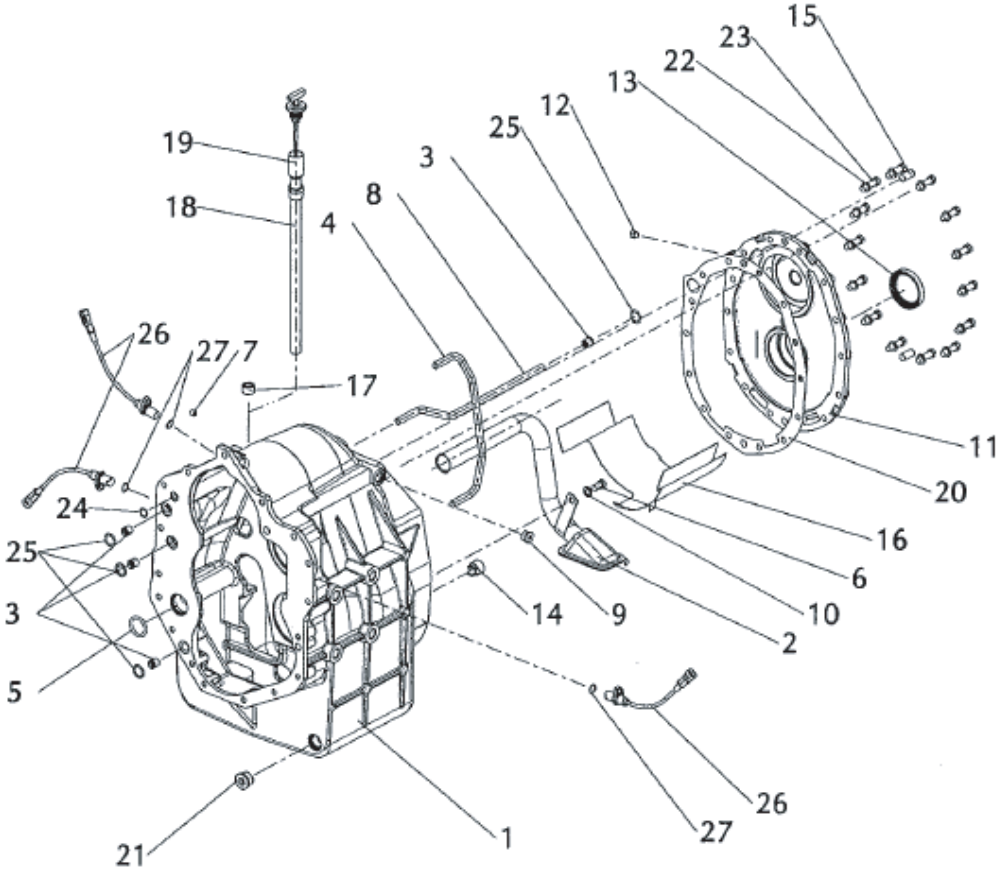


ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing - Converter Assy includes items 1A, 1B, 1C, 1D	1	8	Capscrew	17
1A	Plug	1	9	Lockwasher	17
1B	Plug (N.S.S.)	1	10	Pin - Dowel	1
1C	Plug	1	11	Clip - Sleeve	2
1D	Plug	1	12	Screw - Sleeve Clip	2
2	Sleeve - Converter Housing	2	13	Lockwasher - Sleeve Clip	2
3	Plug (N.I.)	2	14	Sensor - Speed & Screw	1
4	Plug	1	15	O-ring	1
5	O-ring	1	16	Switch - Temperature	2
6	Plug	1	17	Breather - Air	1
7	Gasket - Converter Housing to Transmission Case	1	18	Plug	2

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Transmission Case Group

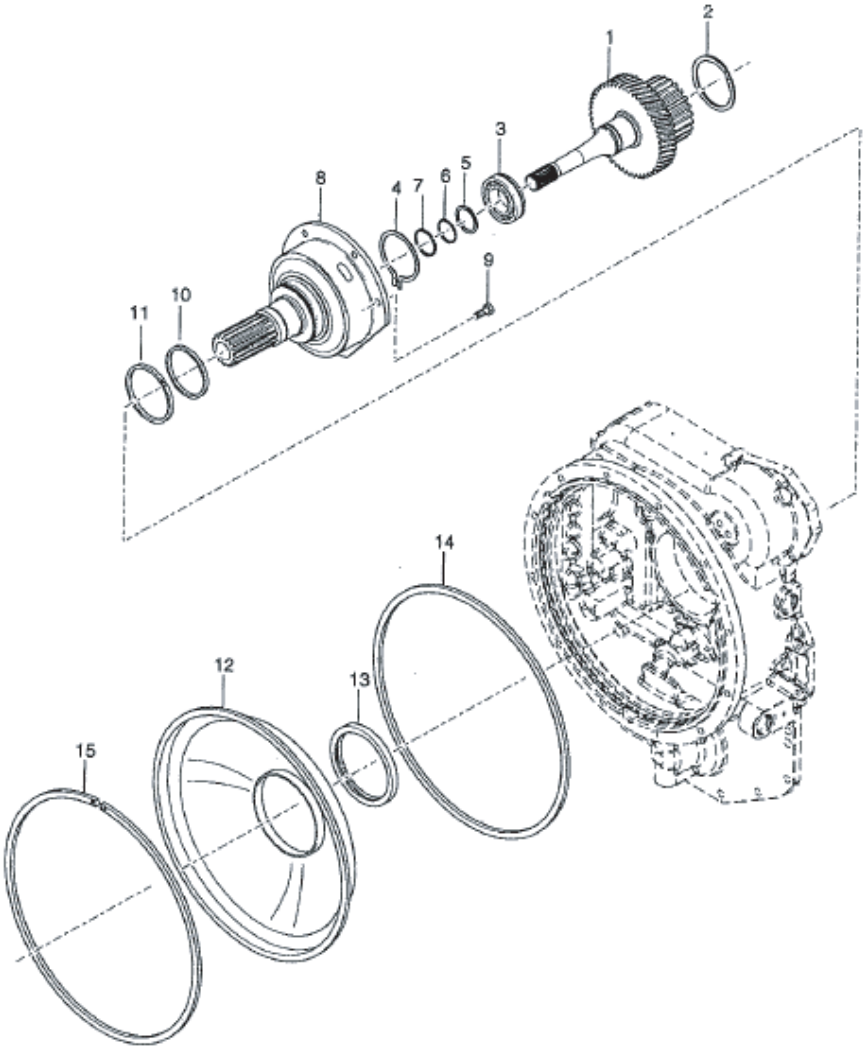


ITEM	DESCRIPTION	QTY
1	Assy - Transmission Case Includes Items 2 thru 10	1
2	Assy - Suction Tube	1
3	Sleeve - Press & Lube Tube	4
4	Tube - 3rd Clutch	1
5	O-ring	1
6	Capscrew	1
7	Plug	1
8	Tube - Low Speed Clutch Pressure	1
9	Plug	1
10	Lockwasher	1
11	Assy - Rear Cover, Plug, & Seal Includes Items 12, 12A, & 13	1
12	Plug	1
12A	O-ring	1
13	Seal - Oil	1
14	Plug - Magnetic	1
15	Pin - Dowel	2
16	Baffle - Oil	1
17	Plug - Dipstick Hole	1
18	Not Used on This Model	
19	Not Used on This Model	
20	Gasket - Rear Cover to Transmission Case	1
21	Fitting - Plug, O-ring Seal	1
22	Lockwasher - Pump Mounting Screw	14
23	Capscrew	14
24	O-ring	1
25	O-ring	4
26	Assy - Speed Sensor 26.3 mm Includes Item 27	3
27	O-ring	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Turbine Shaft & Stator Support Group



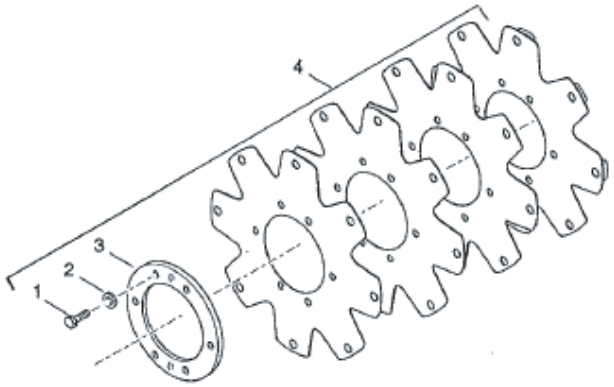
Turbine Shaft & Stator Support Group

ITEM	DESCRIPTION	QTY
1	Shaft - Turbine	1
2	Not Used on This Model	
3	Bearing - Turbine Shaft	1
4	Snap Ring External - Special	1
5	Washer - Bearing Support	1
6	Bearing Retaining Ring	1
7	Piston Ring	1
8	Stator Support	1
9	Screw - Stator Support	6
10	Piston Ring	1
11	Spring - Piston Ring Expander	1
12	Assy - Oil Baffle Includes Item 13	1
13	Seal - Oil Baffle	1
14	Ring - Oil Baffle Seal	1
15	Ring - Oil Baffle Retaining	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Drive Plate Group

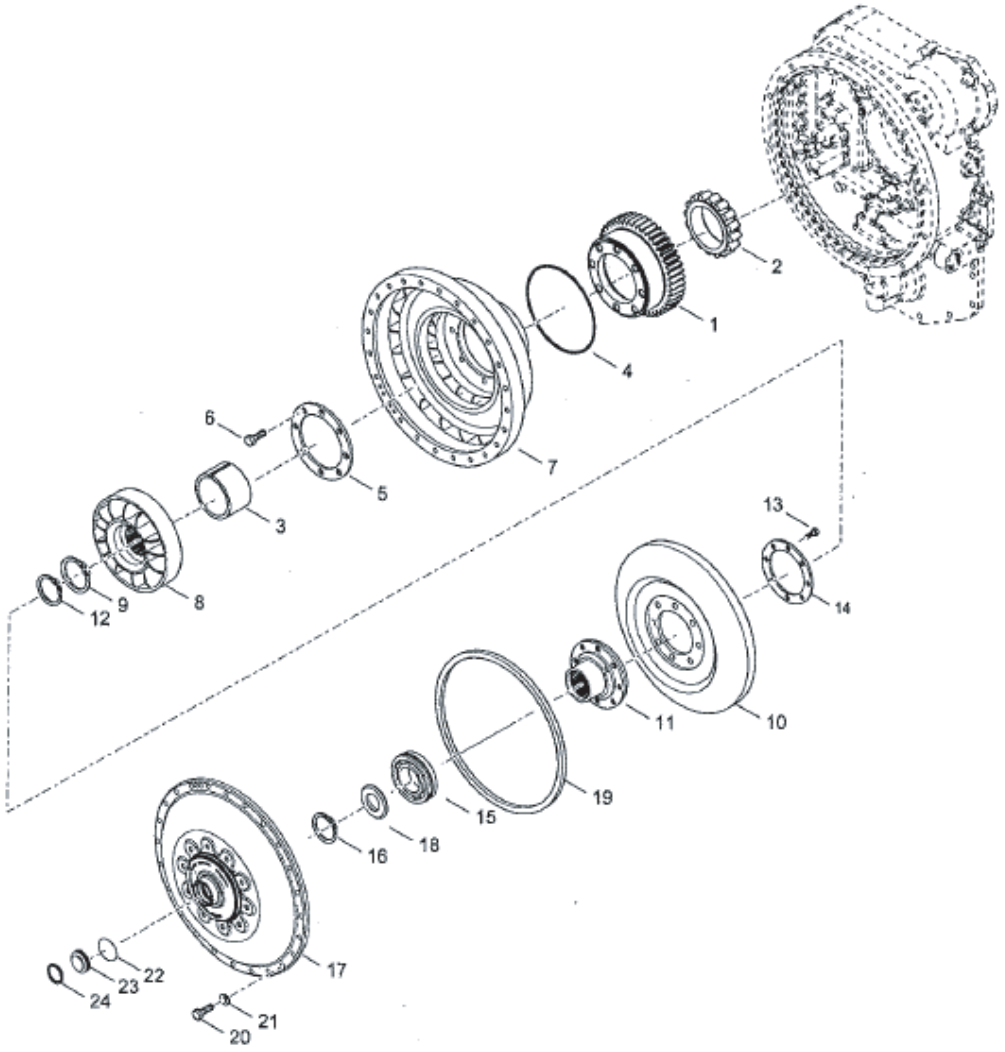


ITEM	DESCRIPTION	QTY
1	Capscrew	10
2	Lockwasher	10
3	Ring - Backing	1
4	Kit - TE10 13.5 Drive Plate Includes Items 1 thru 3	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Torque Converter Assembly Group

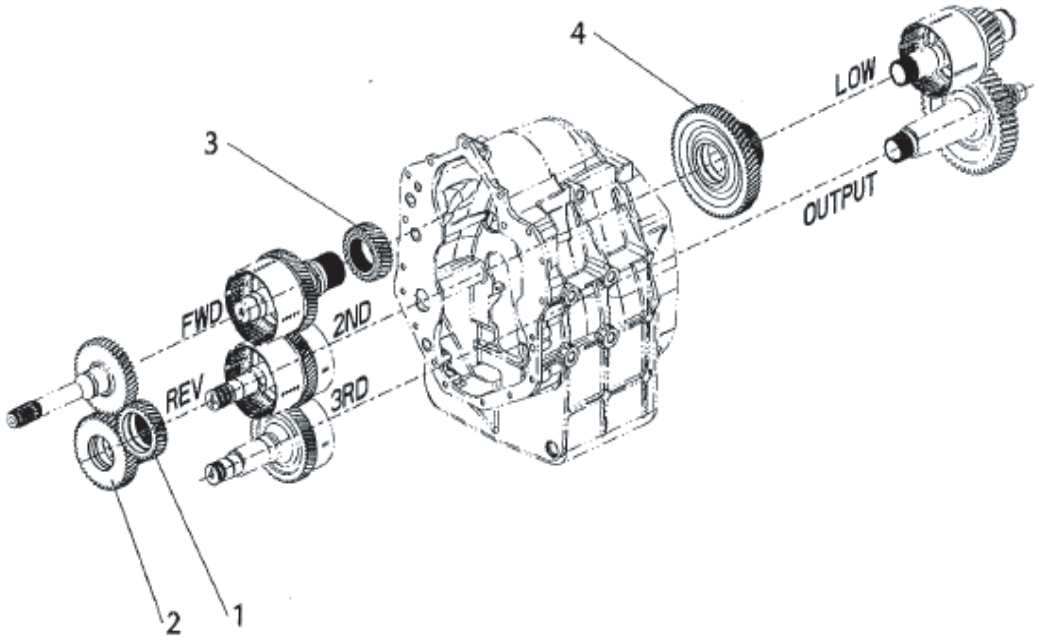


ITEM	DESCRIPTION	QTY
1	Gear - Impeller Hub	1
2	Bearing - Impeller Hub Gear	1
3	Spacer - Without Freewheel	1
4	O-ring - Impeller Hub	1
5	Ring - Backing	1
6	Screw - Turbine Hub	8
7	Impeller	1
8	Member - Reaction 15 blades	1
9	Ring - Reaction Member Retaining	1
10	Hub - Turbine 18 blades	1
11	Hub - Turbine	1
12	Ring - Turbine Hub Retaining	1
13	Screw - Turbine Hub	12
14	Ring - Turbine to Hub Screw	1
15	Bearing - Turbine Hub	1
16	Ring - Turbine Hub Retaining	1
17	Cover - Impeller	1
18	Spacer - Turbine Hub	1
19	O-ring - Impeller to Cover	1
20	Screw - Impeller to Cover	24
21	Lockwasher - Impeller to Cover Screw	24
22	O-ring	1
23	Bore - Plug	1
24	Snap Ring	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Gear Group

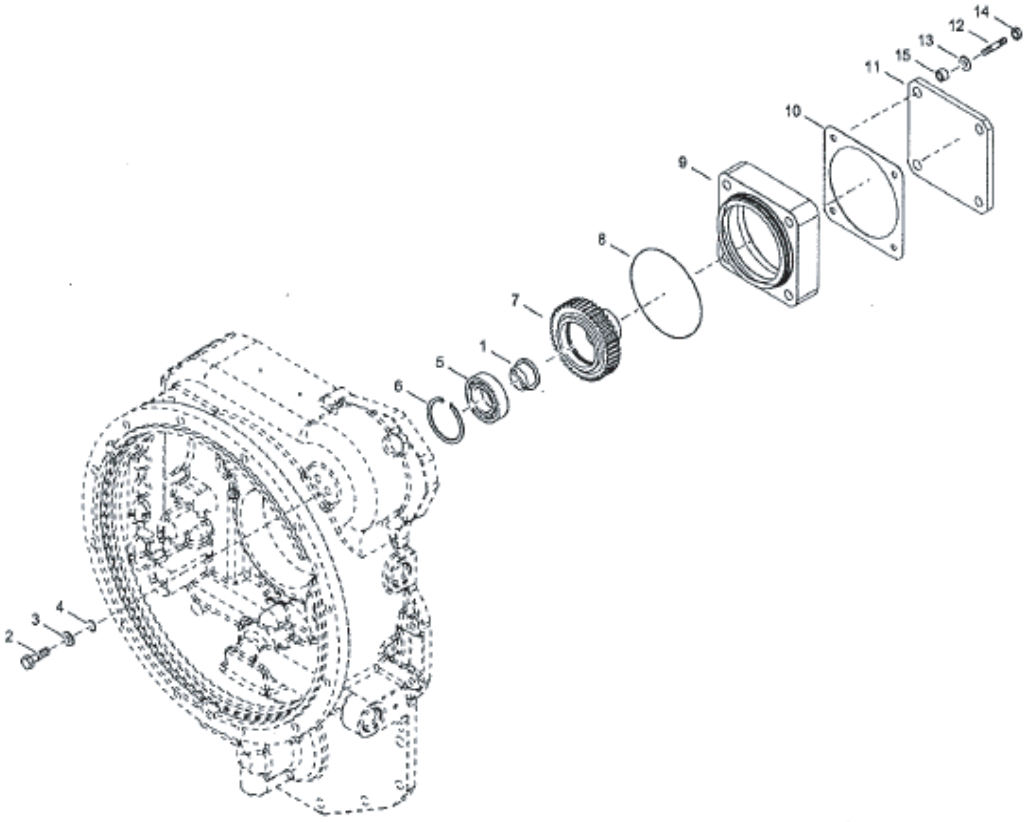


ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Gear - Reverse Idler	1	3	Gear - Forward Shaft	1
2	Gear - Reverse Clutch	1	4	Gear - Low Clutch	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Auxiliary Pump Drive Group

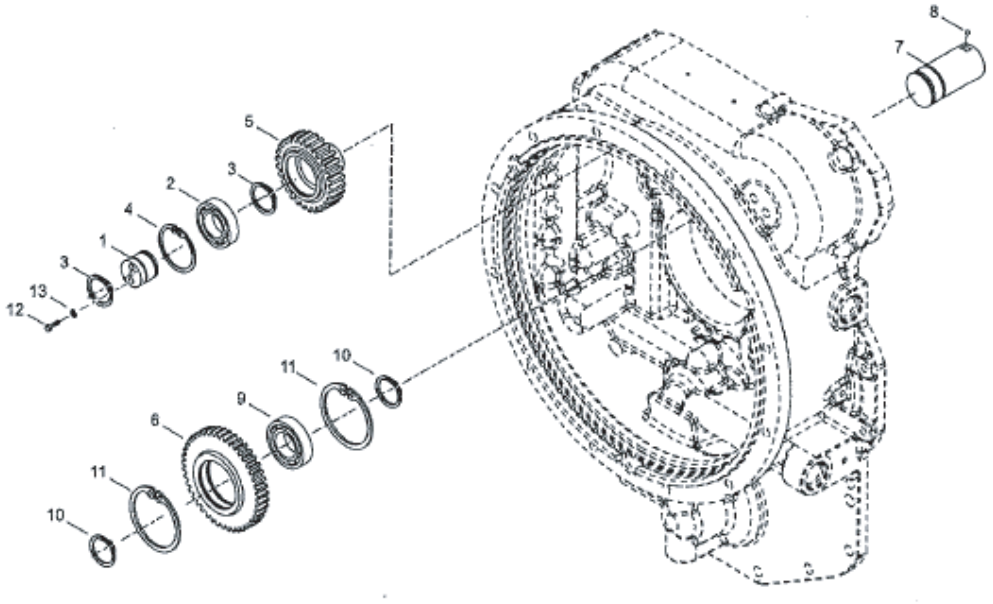


ITEM	DESCRIPTION	QTY
1	Support - Pump Drive Bearing	1
2	Capscrew	2
3	Washer - Bearing Support	2
4	Washer - Bearing Support Screw Sealing	2
5	Bearing - Ball	1
6	Ring - Drive Gear Bearing Retainer	1
7	Gear - Pump Drive (46T-10P)	1
8	O-ring	1
9	Adaptor Pump SAE C to SAE C	1
10	Gasket - Pump Mounting Cover	1
11	Cover - Pump Mounting	1
12	Stud - Pump Adaptor	4
13	Lockwasher - Pump Adaptor Screw	4
14	Nut	4
15	Spacer - Pump Adaptor (8mm)	4

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Charging Pump Drive Group

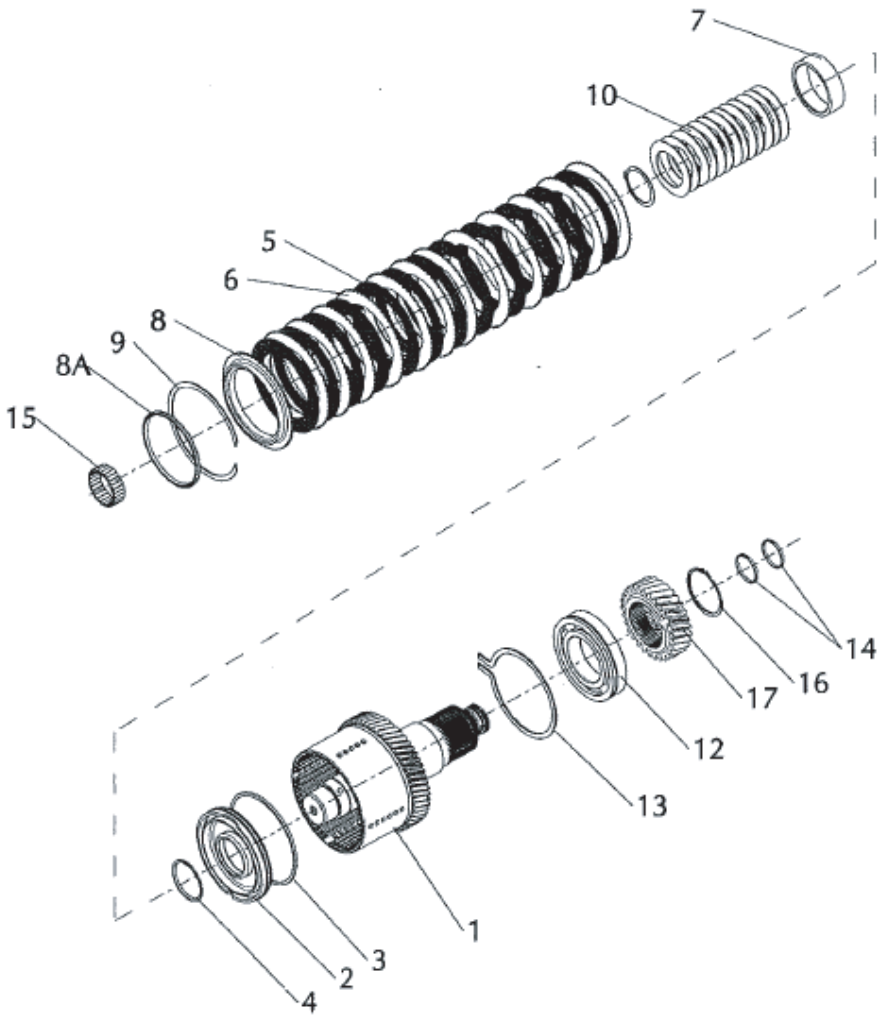


ITEM	DESCRIPTION	QTY
1	Support - Pump Drive Bearing	1
2	Bearing - Pump Drive Gear	1
3	Ring - Drive Gear Bearing Locating	2
4	Ring - Drive Gear Bearing Set	1
5	Gear - Charging Pump Drive	1
6	Gear - Pump Drive Idler	1
7	Shaft - Idler	1
8	Ball - Idler Shaft Lock	1
9	Bearing - Idler Gear Stub Shaft	1
10	Ring - Idler Gear Bearing Locating	2
11	Ring - Idler Gear Bearing Retaining	2
12	Screw - Bearing Support	2
13	Lockwasher - Bearing Support	2

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Forward Shaft Group



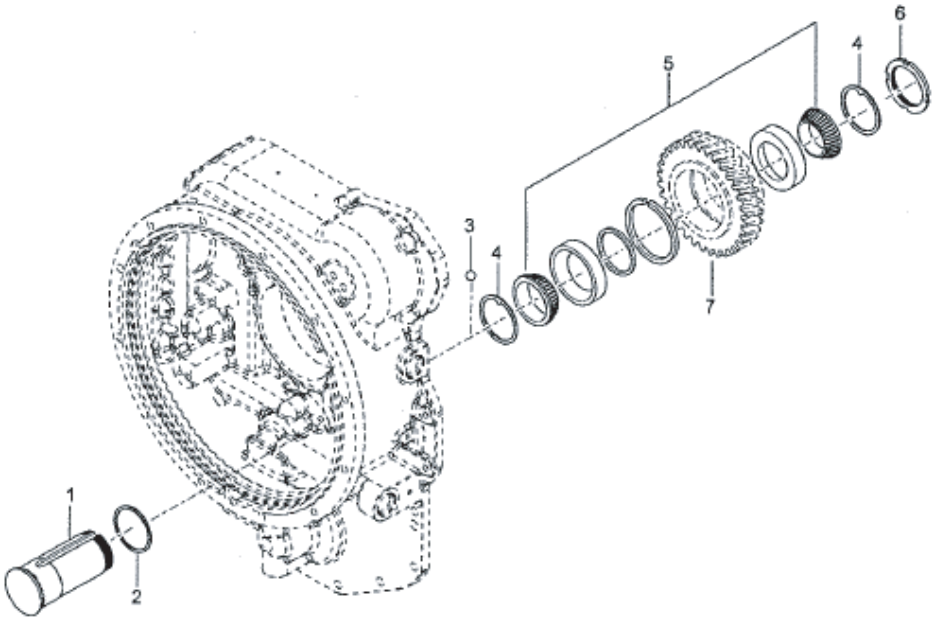
Forward Shaft Group

ITEM	DESCRIPTION	QTY
1	Assy - Forward Shaft, Gear, Drum, & Plug	1
2	Assy - Clutch Piston Includes Items 3 & 4	1
3	Seal - Clutch Piston, Outer	1
4	Seal - Clutch Piston, Inner	1
5	Disc - Inner	12
6	Disc - Outer	12
7	Spacer - Clutch Piston Spring	1
8	Assy - End Plate & Seal Includes Item 8A	1
8A	Seal Lip	1
9	Snap Ring - Backing Plate	1
10	Assy - Disc Spring Includes 13 washers	1
11	Snap Ring - Retaining	1
12	Bearing - Ball	1
13	Ring - Bearing Retaining	1
14	Piston - Ring	2
15	Bearing - Forward Shaft Pilot	1
16	Ring - Gear Retaining	1
17	Forward Shaft Gear (see “Gear Group”, on page 55)	

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Reverse Idler Group

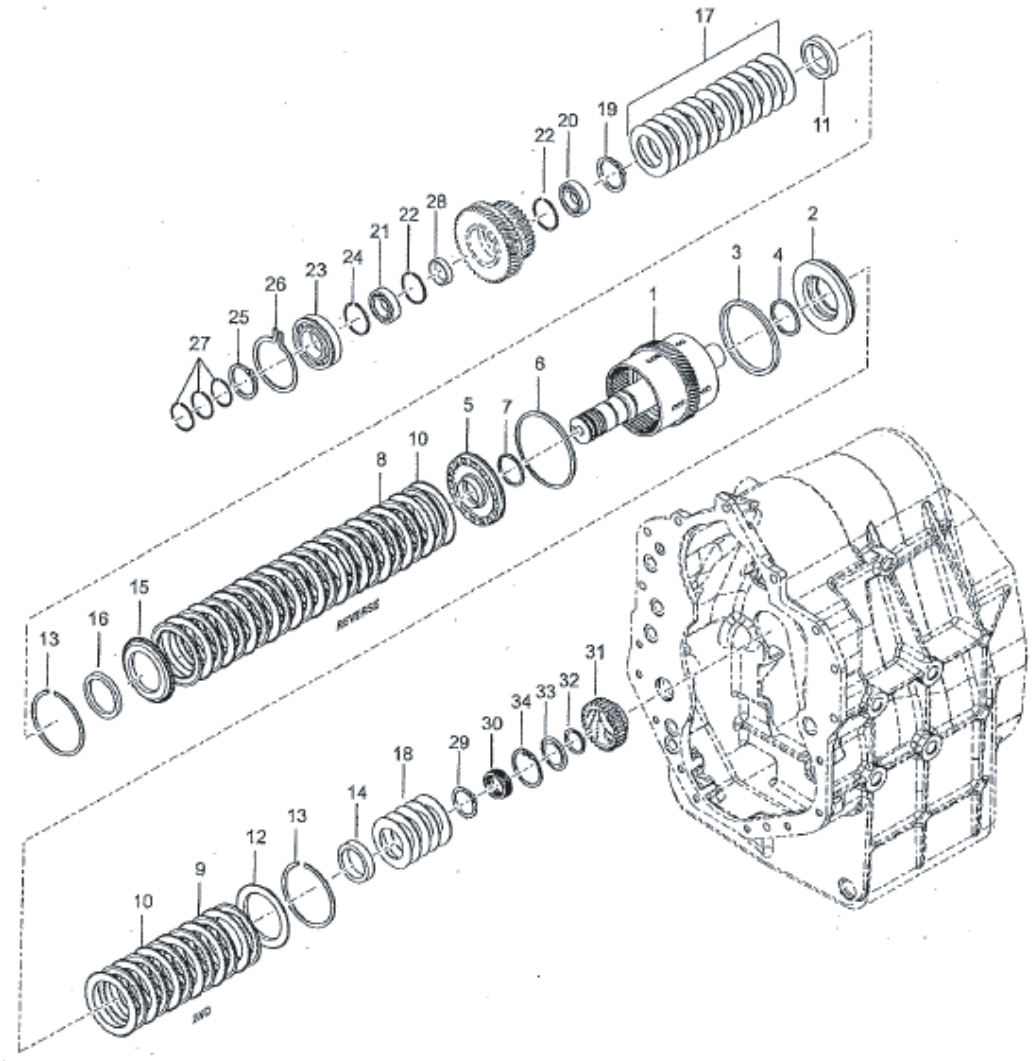


ITEM	DESCRIPTION	QTY
1	Shaft - Reverse Idler	1
2	O-ring - Idler Shaft	1
3	Ball	1
4	Washer - Tanged	2
5	Assy - Bearing	1
6	Nut - Bearing Retaining Plate	1
7	Gear - Reverse Idler (see “Gear Group”, on page 55)	

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Reverse & Second Group

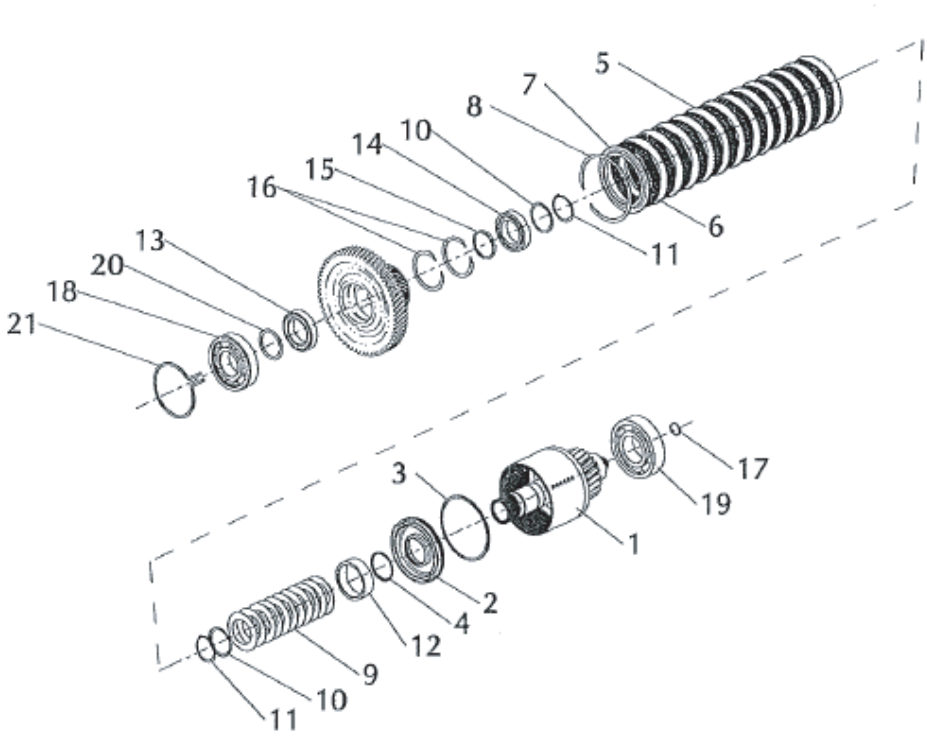


ITEM	DESCRIPTION	QTY
1	Assy - Rev & 2nd Shaft, Gear, Drum, & Plug	1
2	Assy - Clutch Piston Including Items 2 & 3	1
3	Seal - Clutch Piston, Outer	1
4	Seal - Clutch Piston, Inner	1
5	Assy - Clutch Piston Including Items 6 & 7	1
6	Seal - Clutch Piston, Outer	1
7	Seal - Clutch Piston, Inner	1
8	Disc - Inner - Rev	12
9	Disc - Inner - 2nd	6
10	Disc - Outer	18
11	Spacer - Piston Return Spring - Rev	1
12	Plate - Clutch Disc Backing - 2nd	1
13	Snap Ring - Backing Plate	2
14	Spacer - Clutch Piston Spring - 2nd	1
15	Assy - End Plate & Seal Including Item 16	1
16	Seal Lip	1
17	Assy - Disc Spring Including 13 Washers	1
18	Assy - Disc Spring Including 5 Washers	1
19	Snap Ring - 2nd Clutch Disc Hub	1
20	Bearing - Clutch Driven Gear	1
21	Bearing - Ball	1
22	Snap Ring - Front Bearing Rear	2
23	Bearing - Reverse & 2nd Shaft Front	1
24	Snap Ring - Front Bearing Rear	1
25	Snap Ring - Front Bearing Front	1
26	Snap Ring - Front Bearing	1
27	Piston - Ring	3
28	Spacer - Clutch Driven Gear Bearing	1
29	Retaining Ring	1
30	Bearing - Reverse & 2nd Shaft Rear	1
31	Hub - 2nd Clutch	1
32	Retaining Ring	1
33	Retainer - Spring	1
34	Snap Ring - Retainer	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Low Shaft Group

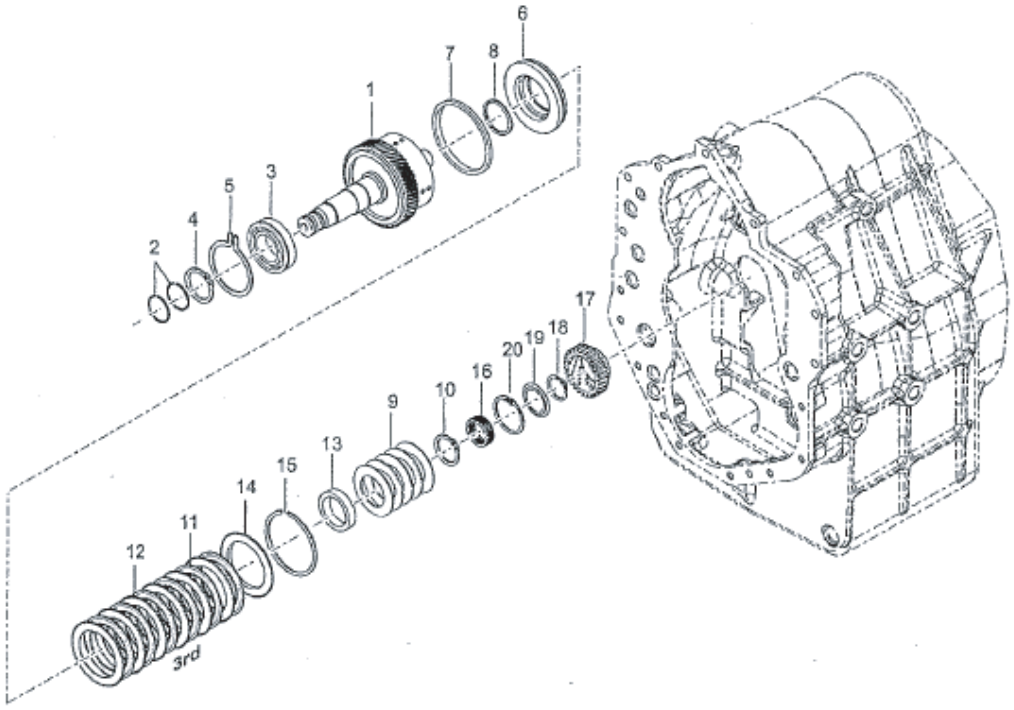


ITEM	DESCRIPTION	QTY
1	Assy - Low Shaft, Hub & Drum	1
2	Assy - Clutch Piston Including Items 3 & 4	1
3	Seal - Clutch Piston, Outer	1
4	Seal - Clutch Piston, Inner	1
5	Plate - Friction	13
6	Disc - Outer	13
7	Plate - Clutch Disc Backing	1
8	Ring - Backing Plate Retaining	1
9	Assy - Disc Spring Including 11 Washers	1
10	Retainer - Spring	2
11	Snap Ring - Spring Retainer	2
12	Spacer - Piston Return Spring	1
13	Bearing - Low Speed Gear	1
14	Bearing - Low Speed Gear	1
15	Spacer - Low Speed Gear Bearing	1
16	Ring - Low Speed Gear Bearing Locating	2
17	Ring - Piston	1
18	Bearing - Low Speed Clutch Shaft Front	1
19	Bearing - Low Speed Clutch Shaft Rear	1
20	Spacer - Front Bearing	1
21	Snap - Ring External	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Third Group

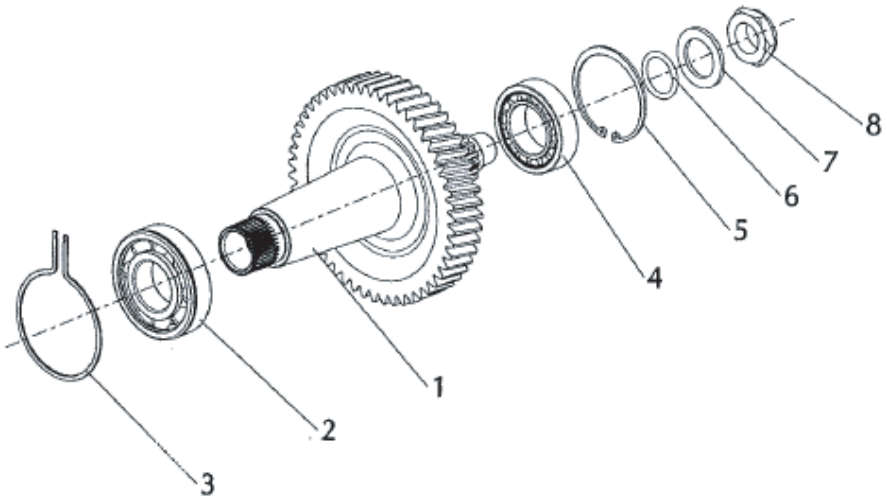


ITEM	DESCRIPTION	QTY
1	Assy - 3rd Shaft, Gear, Drum, & Plug	1
2	Piston - Ring 3rd Clutch Shaft Cast Iron	2
3	Bearing - 3rd Clutch Shaft Front	1
4	Snap Ring - Front Bearing Next to Piston Ring Groove	1
5	Snap Ring - 3rd Clutch Shaft Front Bearing	1
6	Assy - Clutch Piston Including Items 7 & 8	1
7	Seal - Clutch Piston, Outer	1
8	Seal - Clutch Piston, Inner	1
9	Assy - Disc Spring Including 5 Washers	1
10	Retaining Ring	1
11	Disc - Inner	4
11A	Disc - Inner (Mount closest to the clutch piston)	2
12A	Plate - Friction	2
12	Plate - Friction	5
13	Spacer - Clutch Piston Spring	1
14	Plate - Clutch Disc Backing	1
15	Snap Ring - Backing Plate	1
16	Bearing - 3rd Clutch Shaft Pilot	1
17	Hub - 3rd Clutch	1
18	Snap Ring - 3rd Clutch Disc Hub	1
19	Retainer	1
20	Snap Ring - Retainer	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Output Shaft Group

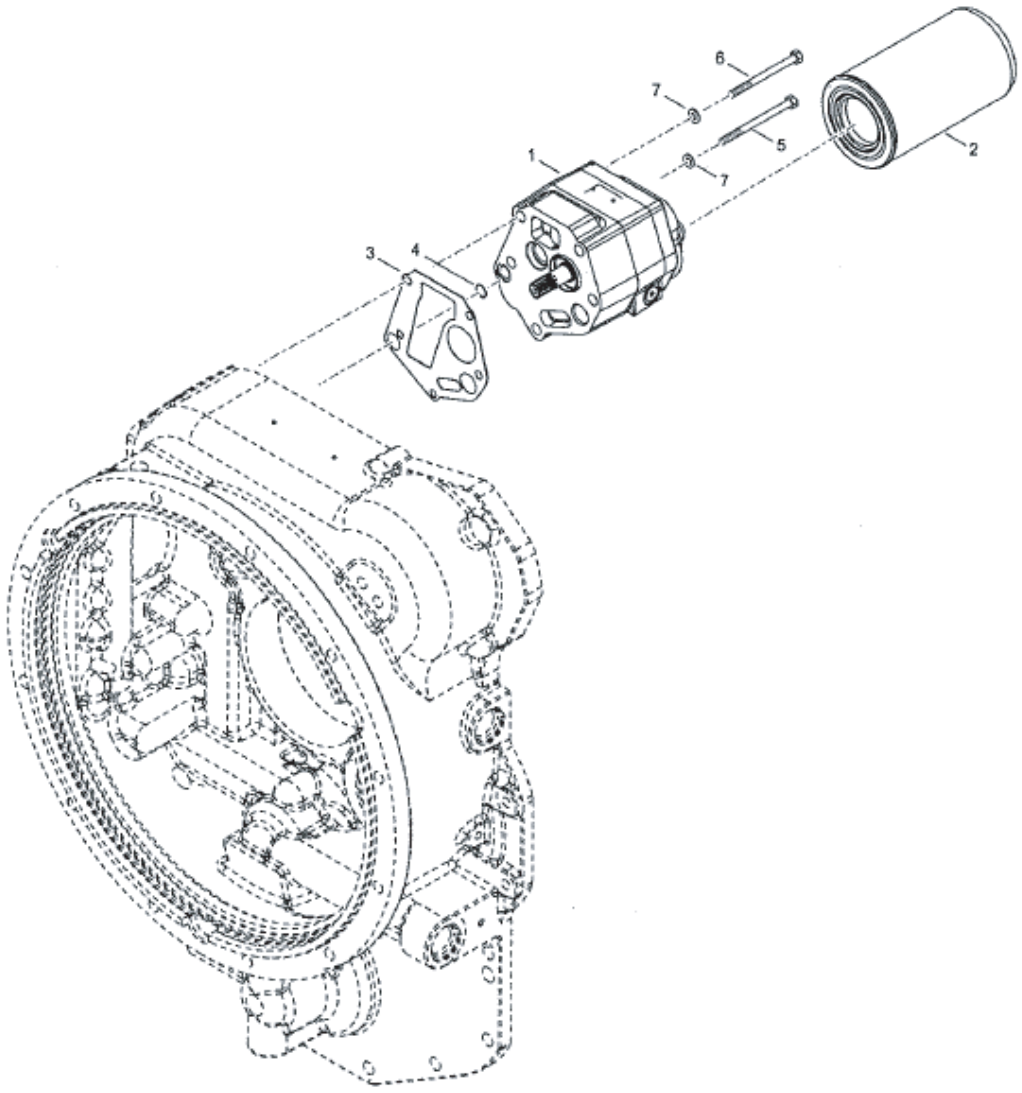


ITEM	DESCRIPTION	QTY
1	Shaft - Output	1
2	Bearing - Ball	1
3	Snap Ring External - Special	1
4	Bearing - Output Shaft Rear	1
5	Ring - Snap	1
6	O-ring	1
7	Washer - Flange	1
8	Nut - Flange	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Charging Pump & Filter Assembly Group



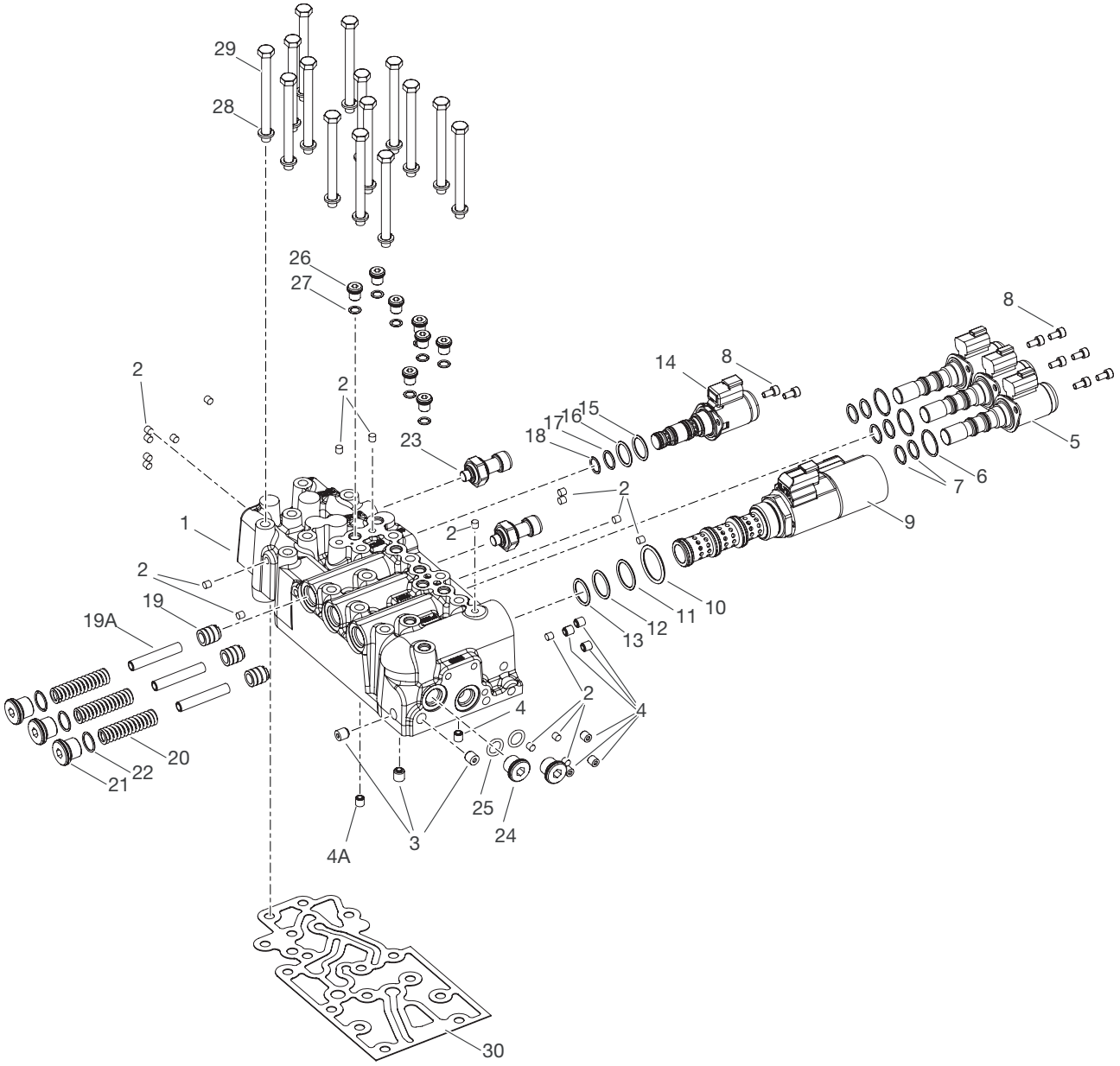
Charging Pump & Filter Assembly Group

ITEM	DESCRIPTION	QTY
1	Assy - Charging Pump	1
2	Assy - Oil Filter	1
3	Gasket - Pump Assy to Converter Housing	1
4	O-ring	1
5	Screw - Pump Mounting	4
6	Screw - Pump Mounting	1
7	Lockwasher - Pump Mounting Screw	5

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

Control Valve Group



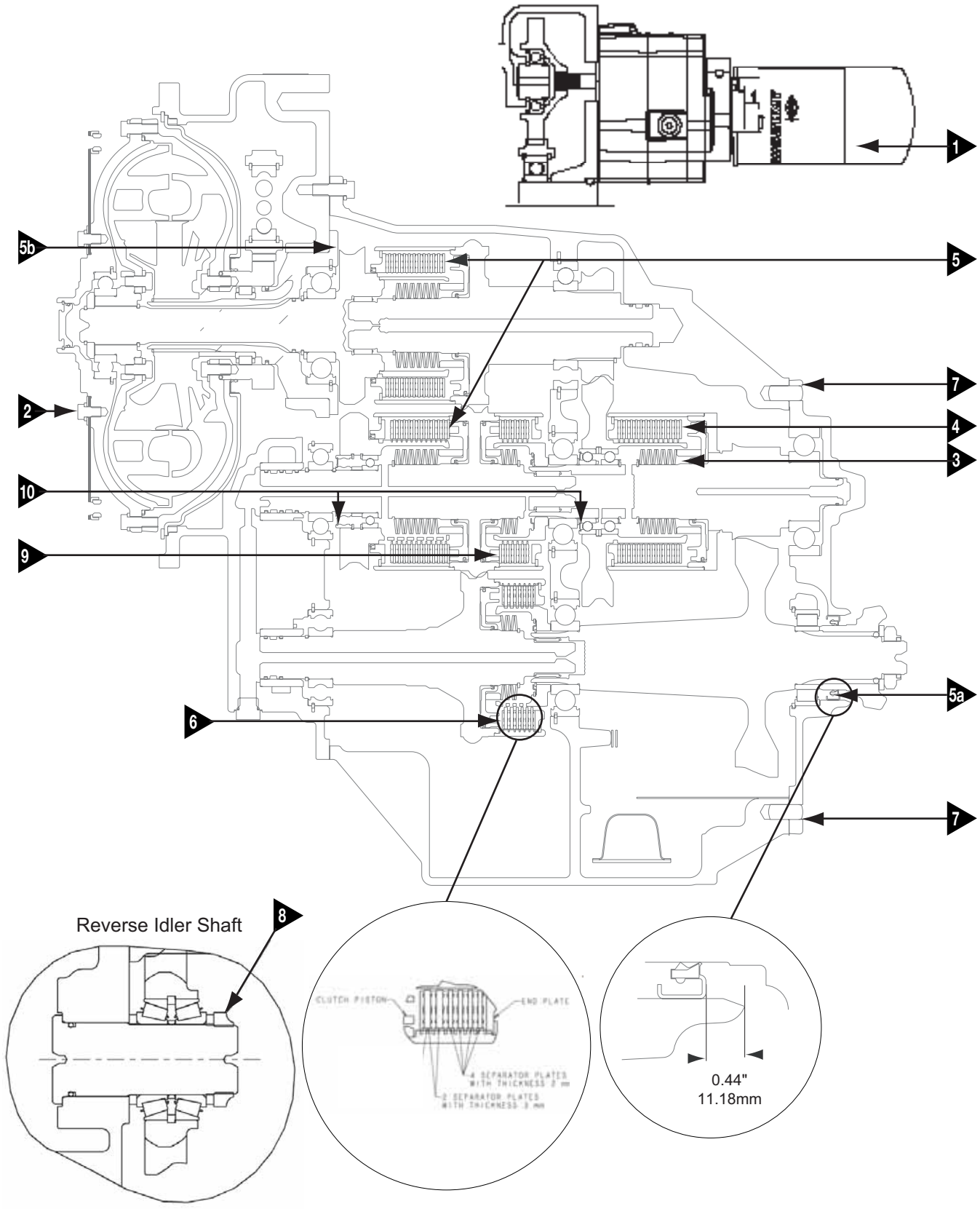
ITEM	DESCRIPTION	QTY
1	Assy - Control Valve & Plugs Including items 2 thru 4A	1
2	Plug - Expansion N.S.S.	19
3	Plug - Expansion N.S.S.	3
4	Plug - Expansion N.S.S.	7
4A	Plug - Orifice 0.8mm	1
5	Solenoid - Valve	3
6	O-ring	3
7	O-ring	6
8	Capscrew	8
9	Assembly - Solenoid Including items 10 thru 13	1
10	O-ring	1
11	O-ring	1
12	O-ring	1
13	O-ring	1
14	Solenoid - Drop-in	1
15	O-ring	1
16	O-ring	1
17	O-ring	1
18	O-ring	1
19	Spool	3
19A	Pin - Accumulator Stop	3
20	Spring - Accumulator	3
21	Plug Includes item 22	3
22	O-ring	3
23	Sensor - Valve Pressure	2
24	Plug Includes item 25	2
25	O-ring	3
26	Plug Includes item 27	8
27	O-ring	8
28	Lockwasher	15
29	Capscrew	15
30	Gasket - Valve to Transmis-sion Case	1

N.S.S. = Not Sold Separately

N.I. = Not Illustrated

INSTALLATION DIAGRAMS

Transmission Assembly Instructions

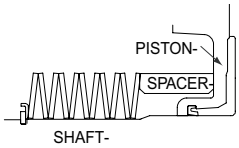


- All lead in chamfers for oil seals, piston rings, and “O”-rings must be smooth and free from burrs. Inspect at assembly.
- Lubricate all piston ring grooves and “O”-rings with oil before assembly.
- Apply a thin coating of grease between seal lips on lip type seals prior to assembly.
- Use only pre-coated pipe plugs. On uncoated pipe plugs apply a light coat of Loctite # 592.
- After assembly of parts using Loctite, there must not be any free or excess material which might enter the oil circuit.
- Apply a light coat of Loctite # 262 or 270 to all thru hole stud holes.

1 Tighten oil filter to 20-25 lbs. ft. [27-34 N•m].

2 Tighten nuts to 30-37 lbs. ft. [40-50 N•m].

3 The clutch springs: The concave side of the first disc spring must be placed against the clutch piston wear sleeve. The remaining springs of each clutch to be stacked alternately reversed. NEVER mix springs.



⚠WARNING

HEAVY SPRING LOAD! Use the correct tools to assemble and disassemble this item!

4 13 outer steel plates / 13 inner plates alternatively assembled, starting with outer steel plate. Clearance between clutch piston and steel separator plate to be .153-.232” [3.9 - 5.9 mm].

5 12 outer steel plates / 12 inner plates alternatively assembled, starting with outer steel plate. Clearance between clutch piston and steel separator plate to be .142-.220” [3.6 - 5.6 mm]

5a Apply Loctite 641 to the O.D. of the seals.

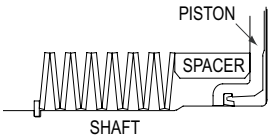
5b Torque to 12-16 lbs. ft. [12-22 N•m].

6 2 separator plates with inner splines and thickness 3±0.06mm (mounted closest to the clutch piston / 5 friction plates (friction on both sides) with outer splines / 4 separator plates with inner splines and thickness 2±0.06 mm / 2 one-side friction plates with outer splines. Clearance between clutch piston and steel separator plate to be .072-.152” [1.82 - 3.87 mm].

7 Apply Loctite 510 around dowel holes or dowel pins.

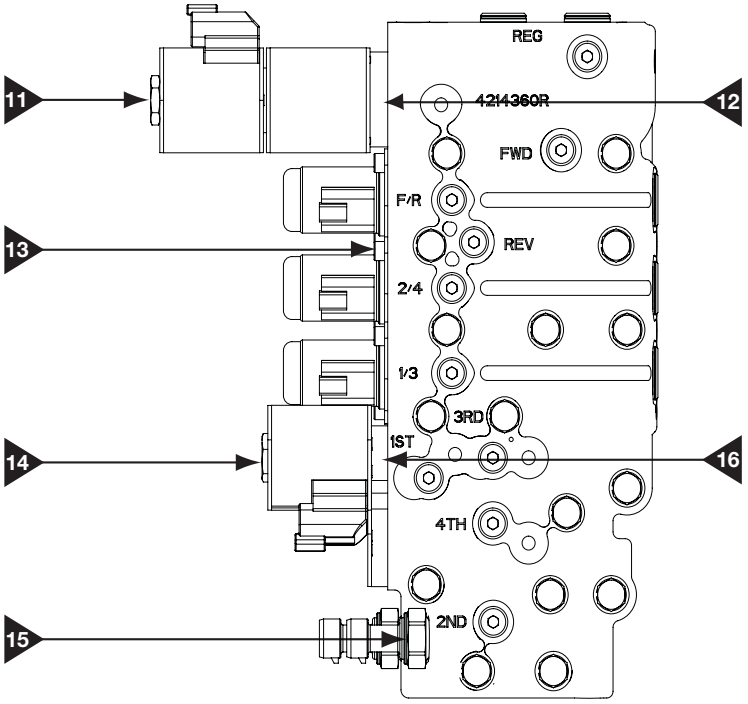
8 Tighten to 200 - 250 lbs. ft. [271 - 340 N•m]
Stake nut securely into shaft notch after tightening to proper torque.

9 6 outer steel plates / 6 inner plates alternately assembled, starting with outer steel plate. Clearance between clutch piston and steel separator plate to be .072-.152” [1.82 - 3.87 mm].



10 Be sure shielded and sealed bearings are mounted as shown.

Control Valve Assembly Instructions



11 Tighten 2 coil nuts to 250-300 lbs.ft. [6.8-9.5 N•m]

12 Tighten 1 valve to 39-54 lbs. ft. [53-73 N•m]

13 Tighten 6 screws to 3.7-4.4 lbs. ft. [5-6 N•m]

14 Tighten 2 coil nuts to 5-7 lbs. ft. [6.8-9.5 N•m]

15 Tighten 2 pressure sensors to 5-8 lbs. ft. [7-11 N•m]

16 Tighten 2 valves to 25-27 lbs. ft. [34-36 N•m]

CLEANING AND INSPECTION

DANGER

Care should be exercised to avoid skin rashes, fire hazards, and inhalation of vapors when using solvent type and alkali cleaners.

Cleaning

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and agitated slowly until parts are thoroughly cleaned of all old lubricants and foreign materials.

Thoroughly dry all cleaned parts immediately by using moisture-free compressed air or soft lint-free absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil, or lapping compound.

BEARINGS

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearings to avoid spinning. DO NOT SPIN BEARINGS WHEN DRYING. Bearings may be rotated slowly by hand to facilitate the drying process.

HOUSINGS, COVERS, AND CAPS

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions, providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft lint-free absorbent wiping rags, free of abrasive materials such as metal filings, contaminated oil, or lapping compound.

Inspection

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

BEARINGS

Carefully inspect all rollers, cages, and cups for wear, chipping, or nicks to determine fitness of bearings for further use. DO NOT REPLACE A BEARING CONE OR CUP INDIVIDUALLY without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lint-free cloth or paper to protect them until installed.

OIL SEALS, GASKETS AND RETAINING RINGS

Replacement of spring loaded oil seals, gaskets, and retaining rings are more economical when the unit is disassembled than to risk premature overhaul to replace these parts at a future time. Loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under the lip of the seal seriously impairs its efficiency. At reassembly, lubricate rings and seals with Multipurpose Lithium Grease Grade 2 for axles and Automatic Transmission Fluid for transmissions.

GEARS AND SHAFTS

If Magna-Flux or a dye penetrant process is available, use this process to check parts. Examine teeth and the ground/polished surfaces of all gears and shafts carefully for wear, pitting, chipping, nicks, cracks, or scoring. If gear teeth are cracked or show spots where case hardening is worn through, replace with new gear. Small nicks may be removed with suitable hone stone. Inspect shafts to make certain they are not sprung, bent, or have twisted splines.

Inspection

HOUSINGS, COVERS, AND CAPS

Inspect housings, covers, and caps to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc. are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which can cause oil leaks or failures.

Getting Started

⚠CAUTION

Cleanliness is of extreme importance in the repair and overhaul of the transmission. Before conducting repairs, the exterior of the unit must be thoroughly cleaned to prevent dirt and foreign debris from entering the transmission.

⚠CAUTION

When maintenance work requires welding, disconnect both connectors from the APC200 and from the control valve unit before any welding is started.

NOTE:

CLUTCH RETURN SPRING PACKS ARE CERTIFIED ACCORDING TO COMPRESSION WEIGHT SPECIFICATIONS AND ARE PRE-PACKED IN QUANTITIES TO REPAIR ONE (1) SPECIFIC CLUTCH.

The disc spring packs are to be used as complete assemblies and care should be taken not to intermix the individual disc springs with disc springs in another clutch or disc spring pack.

Each disc spring assembly is made up of selected springs to precisely match each part within this assembly. Failure to replace all piston return springs can result in unequal deflection within the spring pack. The result of this imbalance may adversely affect overall life of springs.

Transmission Case Disassembly

FIGURE 1: Front view of the TE10 3 speed.

FIGURE 2: Remove the valve assembly:

The area around the valve must be clean and free of any foreign material. See “Cleaning and Inspection”, on page 80.

Unscrew 16 bolts (marked with hexagons on the drawing) some turns.

When all bolts are loose, the valve should move.

Replace 2 bolts by aligning studs.

Remove the remaining 14 hex bolts and valve from the transmission case.

FIGURE 3: Valve assembly removal.

FIGURE 4: Remove oil filter element.It is recommended that a small pan be used to catch remaining oil in element.

FIGURE 5: Remove pressure regulating valve and charging pump screws and washers. Remove pressure regulating valve and charging pump as an assembly.

FIGURE 6: When used remove shipping cover screws and washers. Remove shipping cover plate.

FIGURE 7: Remove auxiliary pump adaptor.

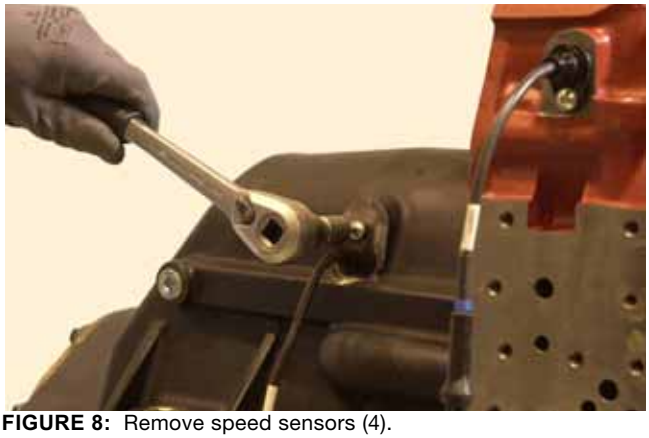


FIGURE 8: Remove speed sensors (4).

FIGURE 9: Remove drive plate nuts and lockwashers. Remove drive plates and backing ring.

FIGURE 10: Remove impeller cover to impeller bolts and lockwashers. Use a small pan to catch the oil left in the converter.

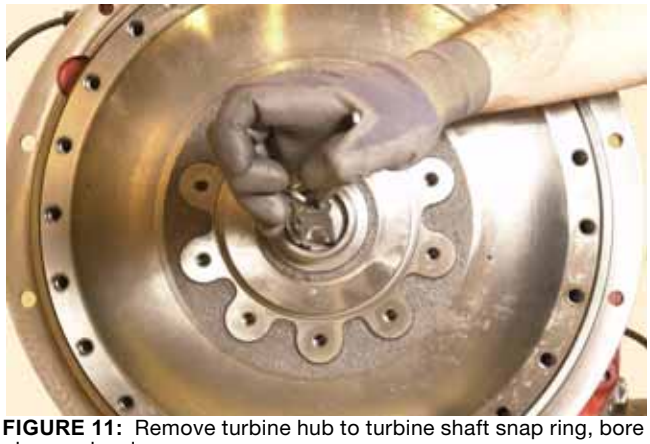


FIGURE 11: Remove turbine hub to turbine shaft snap ring, bore plug, and o-ring.

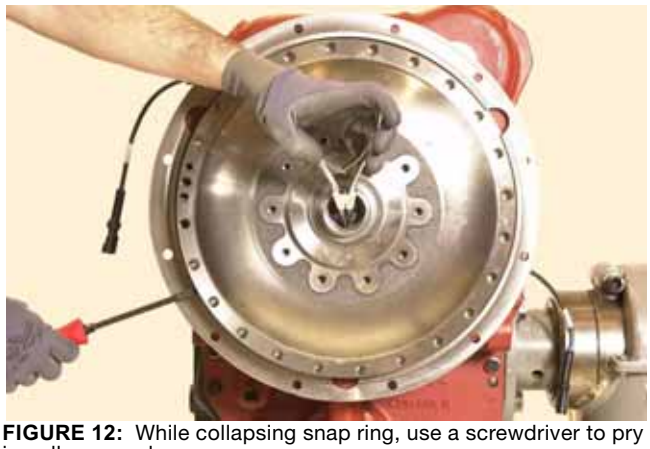


FIGURE 12: While collapsing snap ring, use a screwdriver to pry impeller cover loose.

FIGURE 13: Remove impeller cover.

FIGURE 14: Remove turbine hub retaining ring.

FIGURE 15: Remove reaction member retaining ring.

FIGURE 16: Remove reaction member.

FIGURE 17: Remove reaction member spacer.

FIGURE 18: Remove turbine hub screws

FIGURE 19: Remove backing ring.

FIGURE 20: Remove impeller assembly.

FIGURE 21: Remove oil baffle retaining ring.

FIGURE 22: Remove oil baffle, seal, and seal ring.

FIGURE 23: Remove impeller hub gear and bearing as an assembly.

FIGURE 24: Remove pump drive idler gear set ring.

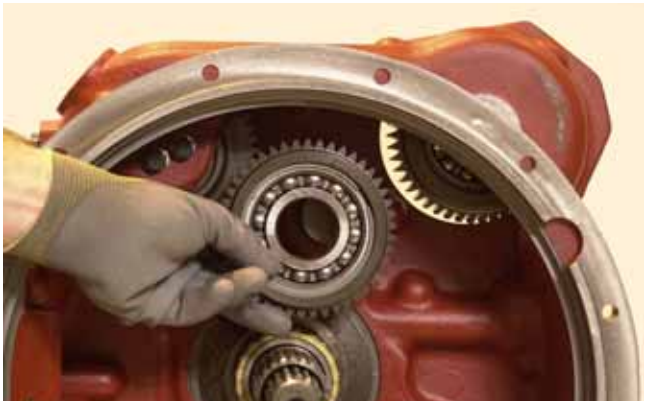


FIGURE 25: Remove idler gear and bearing as an assembly.

FIGURE 26: Remove pump drive gear bearing support bolts. Remove gear and bearing as an assembly.

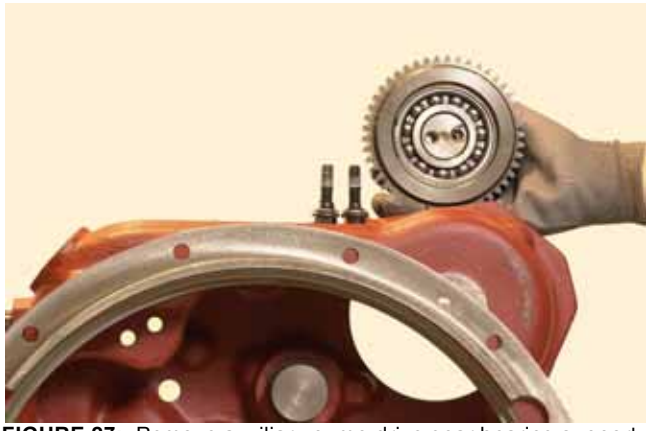


FIGURE 27: Remove auxiliary pump drive gear bearing support bolts. Remove gear and bearing as an assembly from behind.

FIGURE 28: Support converter housing with a chain hoist. Remove converter housing to transmission case bolts.

FIGURE 29: Separate converter housing from transmission case.

NOTE:

Rev/2nd and 3rd clutches will remain in the converter housing.

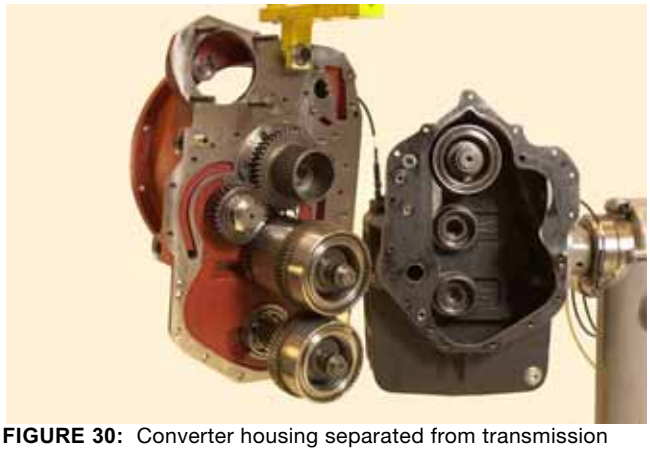


FIGURE 30: Converter housing separated from transmission case.

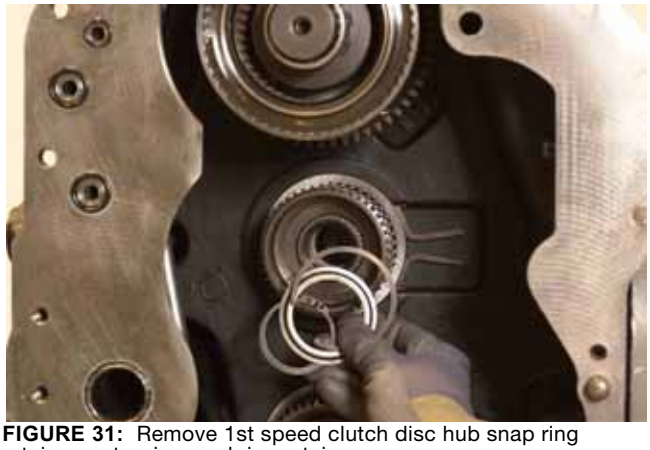


FIGURE 31: Remove 1st speed clutch disc hub snap ring retainer, outer ring, and ring retainer.

FIGURE 32: Remove 2nd speed clutch disc hub.

FIGURE 33: Remove 3rd speed clutch disc hub snap ring retainer, outer ring, and ring retainer.

FIGURE 34: Remove 3rd clutch disc hub.

FIGURE 35: Loosen the flange nut.

FIGURE 36: Remove flange nut, washer, and o-ring.

FIGURE 37: Remove output flange.

FIGURE 38: Remove rear cover screws and lockwashers.

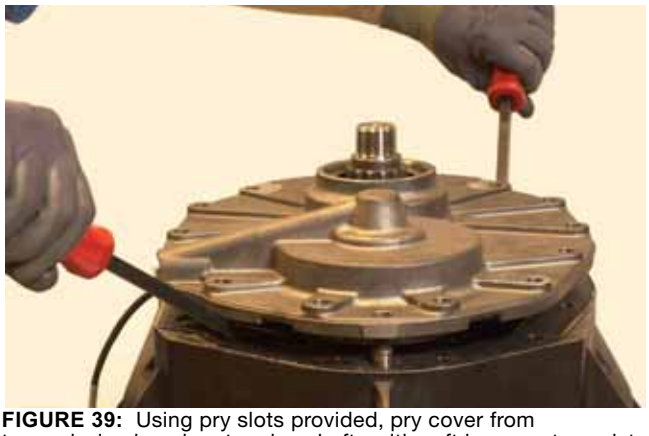


FIGURE 39: Using pry slots provided, pry cover from transmission housing, tapping shafts with soft hammer to assist removal.

FIGURE 40: After the rear cover is removed, remove the rear cover to transmission case gasket.

FIGURE 41: Spread the ears on the 1st speed clutch front bearing snap ring and tap the clutch input shaft from the case.

FIGURE 42: Spread the ears on the 3rd speed clutch front bearing snap ring and tap the clutch input shaft from the case.

FIGURE 43: Attach bearing puller to low clutch shaft rear bearing.

FIGURE 44: Remove low clutch shaft rear bearing.

FIGURE 45: Remove low clutch shaft assembly and output shaft assembly from case.

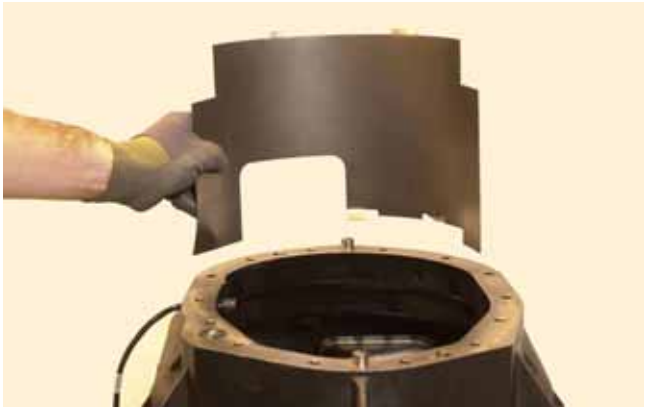


FIGURE 46: Remove oil baffle.

FIGURE 47: Spread the ears on the forward gear shaft bearing retaining ring.

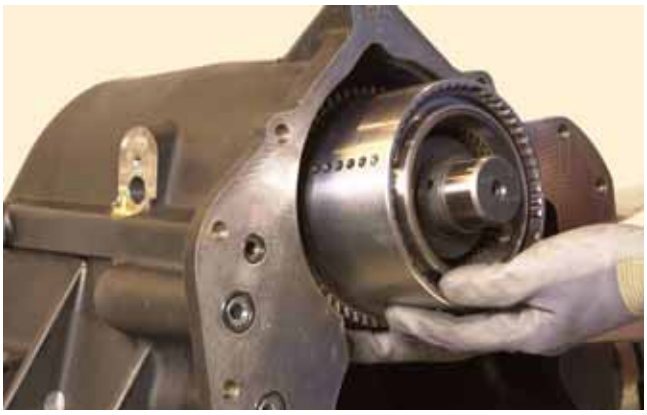


FIGURE 48: Remove forward gear shaft assembly.

FIGURE 49: Remove suction tube assembly capscrew and lockwasher.

Converter Housing Disassembly

FIGURE 50: Remove reverse/2nd clutch shaft rear bearing and 3rd clutch shaft pilot bearing.

FIGURE 51: Remove forward clutch shaft pilot bearing.

FIGURE 52: Spread ears on 3rd clutch front bearing snap ring. Pull 3rd clutch assembly from converter case.

FIGURE 53: Spread ears on reverse/2nd clutch front bearing snap ring. Pull reverse/2nd clutch assembly from converter case.

FIGURE 54: Loosen reverse idler shaft nut.

FIGURE 55: Remove reverse idler shaft nut and washer.

FIGURE 56: Attach bearing puller to reverse idler gear and bearing assembly.

FIGURE 57: Remove bearing spacer.

FIGURE 58: Tap reverse idler shaft from case.

FIGURE 59: Remove inner taper bearing and spacer.

FIGURE 60: Remove idler shaft. Use caution not to lose shaft lock ball.

FIGURE 61: Spread ears on turbine shaft bearing locating snap ring. Tap turbine shaft and bearing assembly from stator support.

FIGURE 62: If stator support is to be removed. Remove stator support screws and tap stator support from converter case.

FIGURE 63: Remove oil sealing ring sleeve retainer screw and washer. Remove sleeve lock.

FIGURE 64: Attach sleeve puller to sleeve.

FIGURE 65: Remove sleeve.

Forward Clutch Disassembly

FIGURE 66: Remove end plate retaining ring.

FIGURE 67: Remove end plate.

FIGURE 68: Remove inner and outer discs.

FIGURE 69: Compress piston return disc spring pack and remove spring retainer snap ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 1350 N•m.

FIGURE 70: Remove piston return disc spring pack.

NOTE:

DO NOT MIX DISC SPRINGS WITH ANY OTHER DISC SPRINGS AS THEY ARE MATCHED SPRING PACKS.

FIGURE 71: Remove return spring spacer.

FIGURE 72: Remove clutch piston.

FIGURE 73: Turn clutch over and remove clutch shaft piston rings (2).

FIGURE 74: Remove snap ring.

FIGURE 75: Remove forward shaft gear.

FIGURE 76: Attach bearing puller to forward shaft bearing and remove.

Forward Clutch Reassembly

FIGURE 77: Install new clutch piston inner sealing ring. Refer to the “Cleaning and Inspection” pages.

NOTE:

Ring must be sized before installing clutch piston in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring. Rotate piston until seal ring is flush with outer diameter of piston.

FIGURE 78: Install new clutch piston inner sealing ring.

FIGURE 79: Install piston return spring spacer.

FIGURE 80: Install piston return disc springs. First spring with large diameter towards spacer. Alternate (13) disc springs.

NOTE:

DO NOT MIX DISC SPRINGS WITH ANY OTHER DISC SPRINGS AS THEY ARE MATCHED SPRING PACKS.

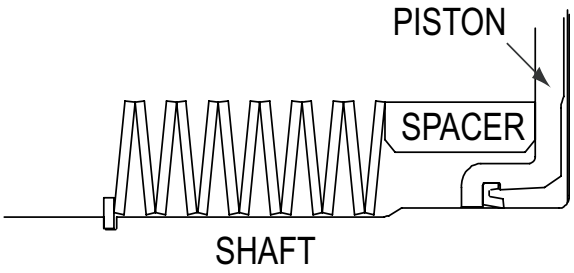


FIGURE 81: Spring and spacer position.

FIGURE 82: Compress return disc springs and install spring retaining snap ring. Be sure snap ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Force of spring is 1350 N•m.

FIGURE 83: Install one (1) steel disc. Install one (1) friction disc. Alternate steel and friction discs until proper amount are installed. First disc next to the piston is steel, last disc installed is friction.

FIGURE 84: Install new seal in clutch end plate. Install end plate in clutch drum.

FIGURE 85: Install end plate retaining ring.

FIGURE 86: Install bearing.

FIGURE 87: Install forward shaft gear.

FIGURE 88: Install snap ring.

FIGURE 89: Turn clutch over and install clutch shaft piston rings (2).

First Clutch Disassembly

FIGURE 90: Attach bearing puller to front bearing.

FIGURE 91: Remove front bearing, spacer and low gear.

FIGURE 92: Remove spacer.

FIGURE 93: Remove end plate retaining ring.

FIGURE 94: Remove end plate.

FIGURE 95: Remove inner and outer discs.

FIGURE 98: Remove bearing locating ring snap ring.

FIGURE 96: Remove bearing.

FIGURE 99: Compress return spring and remove return spring retaining snap ring.

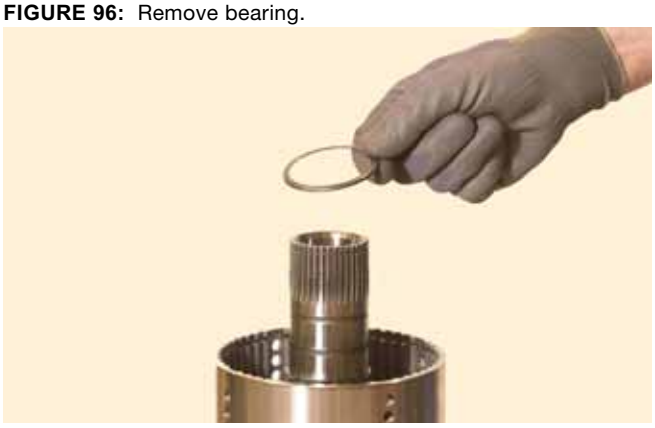


FIGURE 97: Remove bearing locating ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 1360 N•m.

FIGURE 100: Remove return spring retaining ring retainer.

FIGURE 101: Remove piston return disc springs.

NOTE:

DO NOT MIX DISC SPRINGS WITH ANY OTHER DISC SPRINGS AS THEY ARE MATCHED SPRING PACKS.

FIGURE 102: Remove piston spacer.

FIGURE 103: Remove clutch piston.

FIGURE 104: Turn clutch over and remove clutch shaft piston ring (1).

First Clutch Reassembly

FIGURE 105: Install new clutch piston inner sealing ring. Refer to the “Cleaning and Inspection” pages. The bleed valve in the clutch piston must be clean and free of any foreign material.

NOTE:

Ring must be sized before installing clutch piston in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring. Rotate piston until seal ring is flush with outer diameter of piston.

FIGURE 106: Install new clutch piston outer sealing ring and install clutch piston in clutch drum. Use caution as not to damage

newly installed seal rings. The bleed valve in the piston must be clean and free of any foreign material.

FIGURE 107: Install piston spacer.

FIGURE 108: Install piston return springs. First spring with large diameter towards spacer. Alternate eleven (11) springs.

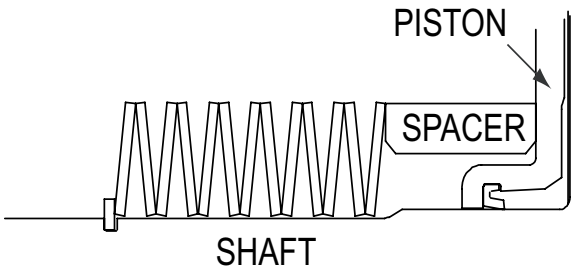


FIGURE 109: Spring and spacer position.

FIGURE 110: Position piston return disc spring retaining ring retainer on clutch shaft.

FIGURE 111: Compress springs and install retainer snap ring. Be sure snap ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Force of spring is 1360 N•m.

FIGURE 112: Install inner bearing locating ring snap ring.

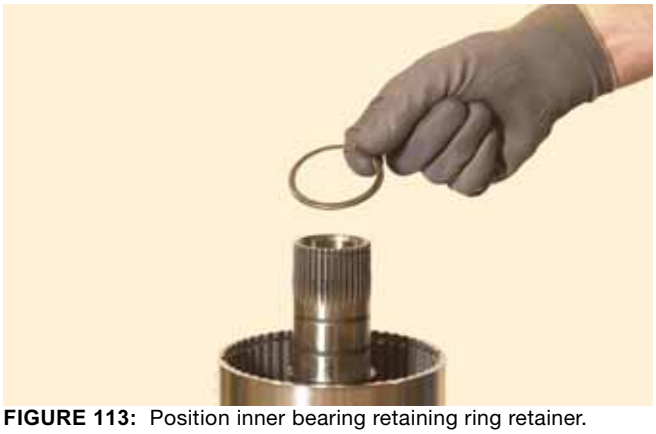


FIGURE 113: Position inner bearing retaining ring retainer.

FIGURE 114: Install one (1) steel disc. Install one (1) friction disc. Alternate steel and friction discs until proper amount of discs are installed. First disc next to piston is steel, last disc is friction.

FIGURE 115: Install clutch end plate.

FIGURE 116: Install end plate retaining ring.

FIGURE 117: Warm clutch driven gear and hub assembly to 248°F [120°C].

Align splines on clutch gear with internal teeth of friction discs and gently put gear into position.

DO NOT FORCE THIS OPERATION.

Gear splines must be in full position with internal teeth of all friction discs.

FIGURE 118: Install front bearing spacer.

FIGURE 119: Warm front bearing to 248°F [120°C] and install on shaft with groove down (as shown).

FIGURE 120: Turn clutch over and install clutch shaft piston ring (1).

Reverse Clutch Disassembly

FIGURE 121: Remove clutch shaft piston rings (3).

FIGURE 122: Remove front bearing retaining ring.

FIGURE 123: Remove front bearing.

FIGURE 124: Remove clutch gear bearing retaining ring.

FIGURE 125: Using a puller as shown, remove reverse gear.

FIGURE 126: Remove bearing spacer.

FIGURE 127: Remove bearing using a bearing puller.

FIGURE 128: Remove end plate retaining ring.

FIGURE 129: Remove end plate.

FIGURE 130: Remove inner and outer clutch discs.

FIGURE 131: Compress piston return discs spring. Remove return spring retainer ring.

⚠WARNING

Use caution when removing snap ring. Force of spring is 1360 N•m.

FIGURE 132: Remove return disc springs.

NOTE:

DO NOT MIX DISC SPRINGS WITH ANY OTHER DISC SPRINGS AS THEY ARE MATCHED SPRING PACKS.

FIGURE 133: Remove piston spacer.

FIGURE 134: Remove clutch piston.

Reverse Clutch Reassembly

FIGURE 135: Install new clutch piston inner sealing ring. See “Cleaning and Inspection”, on page 80.

NOTE:

Ring must be sized before installing clutch piston in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring. Rotate piston until seal ring is flush with outer diameter of piston.

FIGURE 136: Install new clutch piston outer sealing ring and install clutch piston in clutch drum. Use caution as not to damage newly installed seal rings.

FIGURE 137: Remove clutch piston.

FIGURE 138: Install piston return disc springs. First spring with large diameter towards spacer. Alternate thirteen (13) springs.

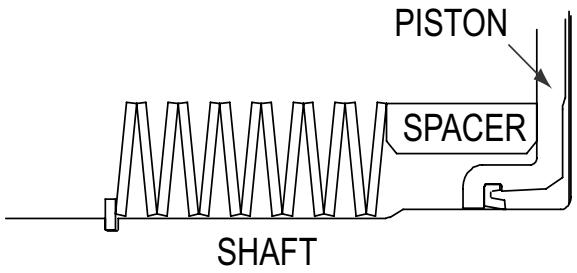


FIGURE 139: Spring and spacer position.

FIGURE 140: Compress return disc springs and install disc spring retainer snap ring. Be sure snap ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Force of spring is 1360 N•m.

FIGURE 141: Install one (1) steel disc. Install one (1) friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is a friction disc.

FIGURE 142: Install new seal in end plate and install end plate in clutch drum.

FIGURE 143: Install end plate retainer ring.

FIGURE 144: Warm reverse gear and hub and bearing assy to 248°F [120°C] Install into clutch drum. Align splines on reverse gear with internal teeth of friction discs.

DO NOT FORCE THIS OPERATION.

Gear splines must be in full contact with internal teeth of all friction discs.

FIGURE 145: Install bearing retaining snap ring.

FIGURE 146: Warn clutch shaft front bearing to 248°F [120°C] and install on clutch shaft with groove up as shown.

FIGURE 147: Install bearing retaining ring.

FIGURE 148: Install clutch shaft piston rings (3).

Second Clutch Disassembly

FIGURE 149: Remove end plate retaining ring.

FIGURE 150: Remove end plate.

FIGURE 151: Remove inner and outer discs.

FIGURE 152: Compress piston return disc springs and remove spring retaining snap ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 1335 N•m.

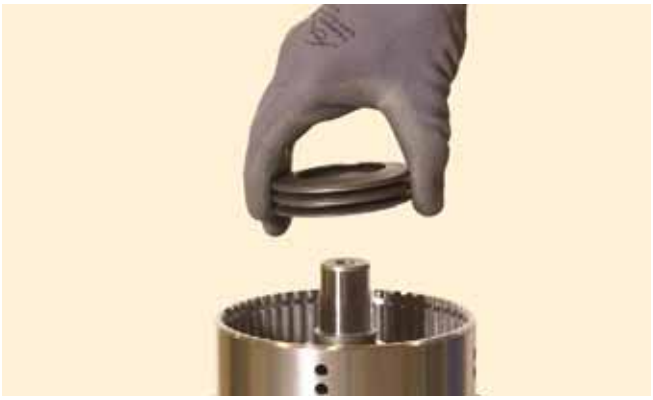


FIGURE 153: Remove piston return disc springs.

FIGURE 154: Remove piston spacer.

FIGURE 155: Remove clutch piston.

Second Clutch Reassembly

FIGURE 156: Install new clutch piston inner sealing rings. Refer to the “Cleaning and Inspection” pages.

NOTE:

Ring must be sized before installing clutch piston in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring. Rotate piston until seal ring is flush with outer diameter of piston.

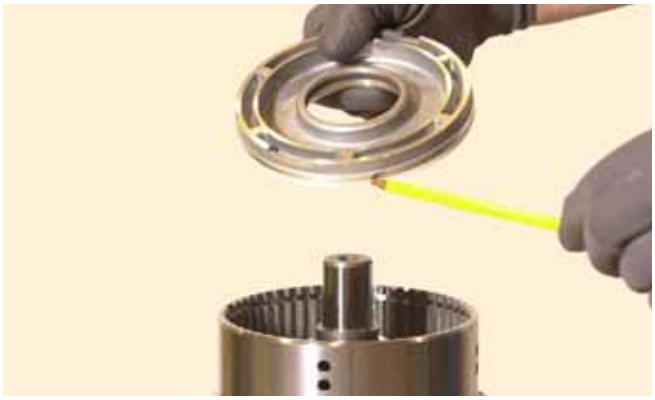


FIGURE 157: Install new clutch piston outer sealing ring and install clutch piston in clutch drum. Use caution as not to damage newly installed seal rings.

FIGURE 158: Install piston return spring spacer.

FIGURE 159: Install piston return disc springs. First spring with large diameter towards spacer. Alternate five (5) springs.

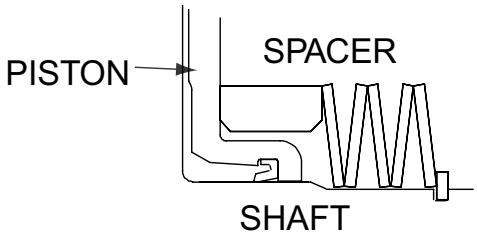


FIGURE 160: Spring and spacer position.

FIGURE 161: Compress return disc springs and install retainer snap ring. Be sure snap ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Force of spring is 1335 N•m.

FIGURE 162: Install one (1) steel disc. Install one (1) friction disc. Alternate steel and friction discs until proper amount are installed. First disc next to piston is steel, last disc installed is friction.

FIGURE 163: Install end plate.

FIGURE 164: Install end plate retaining ring.

Third Clutch Disassembly

FIGURE 165: Remove end plate retaining ring.

FIGURE 166: Remove end plate.

FIGURE 167: Remove inner and outer discs.

FIGURE 168: Compress piston return disc springs and remove spring retaining snap ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 1335 N•m.

FIGURE 169: Remove piston return disc springs.

FIGURE 170: Remove piston spacer.

FIGURE 171: Remove clutch piston.

Third Clutch Reassembly

FIGURE 172: Install new clutch piston inner sealing ring. Refer to the “Cleaning and Inspection” pages.

NOTE:

Ring must be sized before installing clutch piston in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring. Rotate piston until seal ring is flush with outer diameter of piston.

FIGURE 173: Install new clutch piston outer sealing ring and install clutch piston in clutch drum. Use caution as not to damage newly installed seal rings.

FIGURE 174: Install piston return spring spacer.

FIGURE 175: Install piston return disc springs. First spring with large diameter towards spacer. Alternate five (5) springs.

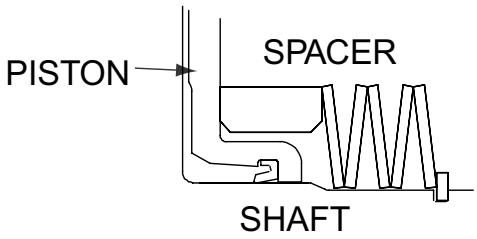


FIGURE 176: Spring and spacer position.

FIGURE 177: Compress return disc springs and install retainer snap ring. Be sure snap ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Force of spring is 1335 N•m.

FIGURE 178: Install half disc.

FIGURE 179: Install one (1) steel disc. Install one (1) friction disc. Alternate steel and friction discs until proper amount are installed. First disc next to piston is steel, last disc installed is friction.

FIGURE 180: Install half disc.

FIGURE 181: Install end plate.

FIGURE 182: Install end plate retaining ring.

Third Clutch Shaft Front Bearing Disassembly

FIGURE 183: Remove piston rings.

FIGURE 184: Remove bearing retaining ring.

FIGURE 185: Using a bearing puller, remove the bearing.

Third Clutch Shaft Front Bearing Reassembly

FIGURE 186: Warm bearing to 248°F [120°C] and install on shaft as shown.

NOTE:

Bearing outer diameter locating ring groove must be up.

FIGURE 187: Install bearing retaining ring.

FIGURE 188: Install piston rings (2).

Turbine Shaft Disassembly

FIGURE 189: Remove oil seal ring.

FIGURE 190: Remove bearing retaining ring and washer.

FIGURE 191: Using a bearing puller, remove the bearing.

Turbine Shaft Reassembly

FIGURE 192: Warm bearing to 248°F [120°C] and install on shaft as shown.

NOTE:

Bearing outer diameter locating ring groove is down.

FIGURE 193: Install washer and bearing retainer.

FIGURE 194: Install oil sealing ring.

Output Shaft Disassembly

FIGURE 195: Remove output shaft snap ring, bearing, and oil seal from the transmission case rear cover.

FIGURE 196: Remove output shaft rear bearing with puller as shown.

FIGURE 197: Remove inner bearing race.

FIGURE 198: Remove bearing on opposite end of shaft.

Output Shaft Reassembly

FIGURE 199: Warm bearing to 248°F [120°C] an install on shaft as shown.

FIGURE 200: Position inner bearing race on shaft.

Turbine Disassembly

FIGURE 201: Remove impeller from cover.

FIGURE 202: Remove turbine retaining ring and tap turbine from turbine cover with a soft hammer.

FIGURE 203: Remove turbine hub spacer.

FIGURE 204: Remove turbine to turbine hub bolts.

FIGURE 205: Remove turbine backing plate.

FIGURE 206: Remove turbine from turbine hub.

Turbine Reassembly

FIGURE 207: Install turbine on turbine hub. Position backing ring in turbine.

FIGURE 208: Install self locking screws. Tighten screws 79-87 N•m [58-64ft.lbs]

NOTE:

Assembly of hub must be completed within a fifteen minute period from start of screw installation. The special screw is to be used for one installation only. If the screw is removed for any reason it must be replaced. The epoxy left in the hub holes must be removed with the proper tap and cleaned with solvent. Dry holes thoroughly and use a new screw for reinstallation.

FIGURE 209: Install spacer, turbine hub bearing, and retaining ring.

FIGURE 210: Install new o-ring in impeller cover. Place turbine assembly in impeller cover.

Converter Case Reassembly

See cleaning and inspection pages.

If stator support was disassembled.

Install new sealing ring and oil sealing ring on support. Press support bearing into position.

NOTE:

Bearing part number must be facing up.

Clean stator support mounting surface and tapped holes with solvent. Dry thoroughly, being certain tapped holes are clean and dry.

Position stator support in converter housing aligning holes in support with holes in housing. Tap support into place with a soft hammer.

Stator support screw assembly.

Install 6 special stator support screws. Tighten screws 12-16 lbs. ft. [16.3-21.6 N•m].

NOTE:

Assembly of stator support to converter housing must be completed within a 15 minute period from start of screw installation. The special screw is to be used for one installation only. If the screw is removed for any reason it must be replaced. The Loctite left in the holes must be removed with the proper tap and cleaned with solvent. Dry hole thoroughly and use a new screw for reinstallation.

FIGURE 211: With new o-ring installed, position idler shaft in converter housing. Align groove in shaft with groove in converter housing. Tap in place.

FIGURE 212: Drop lock ball in position as shown.

FIGURE 213: Install idler shaft spacer.

FIGURE 214: Warm lower taper bearing race to 248°F [120°C] and install on shaft.

FIGURE 215: Install spacer.

FIGURE 216: Install idler gear.

FIGURE 217: Warm idler gear outer tapered bearing race and install on shaft with large diameter up.

FIGURE 218: Install spacer.

FIGURE 219: Install retainer nut and torque to 200-250 lbs. ft.[271.2-338.9 N•m]

FIGURE 220: Stake nut securely in shaft notch.

FIGURE 221: Spread ears on turbine shaft bearing retainer ring located in reaction member support. Tap turbine shaft and bearing into position, being certain bearing snap ring is in full position in snap ring groove.

FIGURE 222: Spread ears on Rev/2nd clutch front bearing locating ring. Tap Rev/2nd clutch drum into place, being certain bearing snap ring is in full position in snap ring groove.

FIGURE 223: Spread ears on 3rd clutch front bearing locating ring. Tap 3rd clutch drum into place, being certain bearing snap ring is in full position in snap ring groove.

Transmission Case Reassembly

FIGURE 224: Install new o-ring and suction tube.

FIGURE 225: Install suction tube bolts and tighten to specified torque. See “Torque Specifications”, on page 131.

FIGURE 226: Install the gear retaining ring.

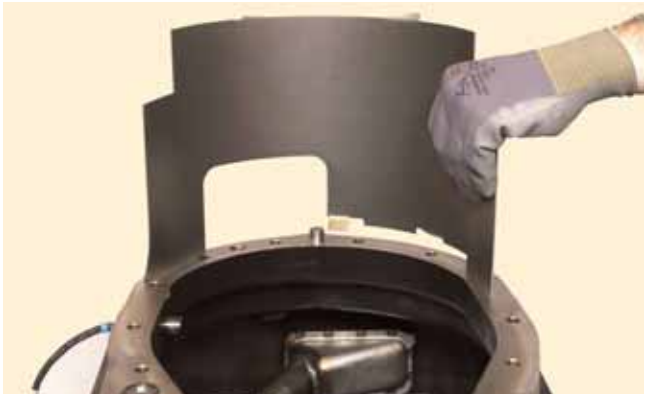


FIGURE 227: Position oil sump oil baffle in case.

FIGURE 228: Install output shaft and 1st clutch assemblies at the same time. Best is to lower the output shaft with a chain hoist whilst installing 1st clutch drum.

FIGURE 229: Warm 1st clutch rear bearing to 248°F [120°C] and install bearing with locating ring groove up as shown.

FIGURE 230: Position a new gasket and o-ring onto the rear transmission case.

NOTE:

A light coat of grease will hold gasket and o-ring into place.

FIGURE 231: Install output seal in transmission rear cover using seal driver.

FIGURE 232: Install output shaft bearing in transmission rear cover using driver.

FIGURE 233: Install output shaft bearing snap ring.

FIGURE 234: The use of aligning studs will facilitate rear cover installation. Tap cover in place.

FIGURE 235: Apply Loctite #262 to rear cover bolts. Install washers and bolts and tighten to specified torque. See “Torque Specifications”, on page 131.

FIGURE 236: Install output flange.

FIGURE 237: Install output flange o-ring, washer, and nut.

FIGURE 238: Tighten flange nut to 200-250 lbs. ft. [271.2-338.9 N•m]

FIGURE 239: Position 2nd speed clutch hub on 1st speed clutch shaft.

FIGURE 240: Install disc hub retaining ring, retaining ring retainer and retainer retaining snap ring.

FIGURE 241: Position 3rd speed clutch disc hub on output shaft.

FIGURE 242: Install disc hub retaining ring, retaining ring retainer and retainer retaining snap ring.

FIGURE 243: Install pilot bearing on low clutch shaft.

FIGURE 244: Position new gasket and o-rings on transmission case.

NOTE:

A light coat of grease will hold gasket and o-rings in place.

FIGURE 245: Install pilot bearing on 2nd and 3rd clutch shaft.

FIGURE 248: Position auxiliary pump drive gear and bearing assembly in converter housing and install capscrews.

FIGURE 246: The use of aligning studs will facilitate aligning the converter housing to the transmission case. Install converter housing assembly to transmission assembly using extreme caution as to align the clutch pilots into the clutch disc hubs. As the clutch pilots enter the disc hubs, turn the turbine shaft and output shaft back and forth. This will help align all of the clutch inner discs with the disc hubs.

DO NOT FORCE THIS OPERATION.

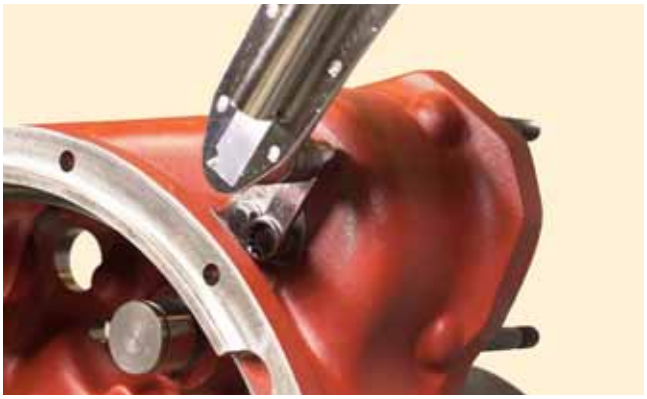


FIGURE 249: Tighten capscrews to specified torque.

FIGURE 247: When all clutches are properly aligned, the converter case will be tight against the transmission housing. Install two (2) housing to housing bolts and lockwashers. Remove aligning studs. Install remaining bolts and lockwashers. Tighten bolts to specified torque. See torque chart.

FIGURE 250: Position charging pump drive gear and bearing assembly. Install capscrews.

FIGURE 251: Tighten capscrews to specified torque. See “Torque Specifications”, on page 131.

FIGURE 252: Install pump idler gear and bearing assembly on shaft.

FIGURE 253: Install idler gear retaining ring.

FIGURE 254: Install o-ring.

FIGURE 255: Install gear.

FIGURE 256: Install tooling AS0024014700.

FIGURE 257: Install oil baffle.

FIGURE 258: Install oil baffle snap ring and remove tooling AS0024014700.

FIGURE 259: Install oil baffle o-ring.

FIGURE 260: Apply a light coat of Permatex #2 to the outer diameter of the oil baffle oil seal. Install impeller assembly and oil baffle using caution as not to cut, break or unhook the oil sealing ring on the support.

FIGURE 261: Install backing ring.

FIGURE 262: Tighten capscrews to specified torque. See “Torque Specifications”, on page 131.

FIGURE 263: Position impeller hub bearing spacer on stator support.

FIGURE 264: Install reaction member with thick side of blades out.

FIGURE 265: Install reaction member retaining ring.

FIGURE 266: Install turbine hub locating ring.

FIGURE 267: With a new impeller cover to impeller o-ring in place, install turbine and impeller cover assembly on turbine shaft.

FIGURE 268: Install turbine hub to turbine shaft retaining ring.

FIGURE 269: Install impeller cover to impeller screws and lockwashers. Tighten screws to specified torque.

FIGURE 272: Install drive plate capscrews and lockwashers.

FIGURE 270: Install o-ring and bore plug.

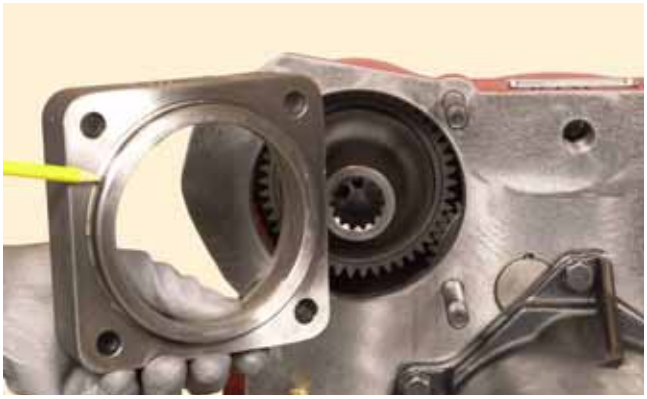


FIGURE 273: Install the auxiliary pump adaptor o-ring.

FIGURE 271: Install bore plug snap ring.

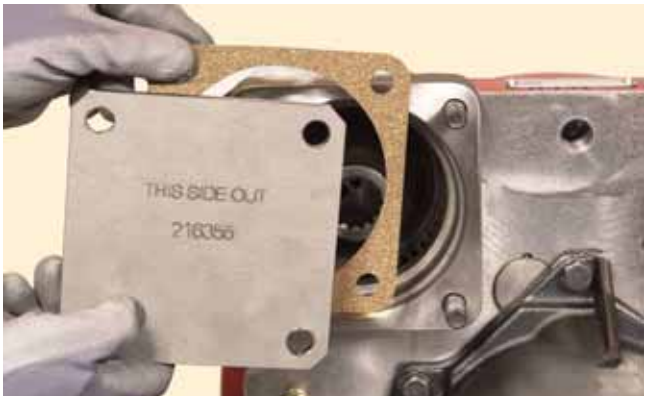


FIGURE 274: Install auxiliary pump adaptor, gasket, and cover.

FIGURE 275: Install cover screws and lockwashers and tighten to specified torque. See “Torque Specifications”, on page 131.

FIGURE 278: Install filter adaptor, washers and capscrews and tighten to specified torque.See “Torque Specifications”, on page 131.

FIGURE 276: Install new charging pump drive gasket.

FIGURE 279: Install new oil filter cartridge.Note: it is recommended that the filter cartridge be changed after 50 and 100 hours of operation on a new and rebuild or repaired unit.

FIGURE 277: Position charging pump assembly on converter housing. Install new o-ring in charging pump. Install washers and capscrews and tighten to specified torque. See “Torque Specifications”, on page 131.

FIGURE 280: Use aligning studs for the reassembly of the control valve to the transmission case. Install new gasket.

FIGURE 281: Mount control valve.

FIGURE 282: Replace the aligning studs with bolts. Install 14 bolts and hand-tighten in the sequence shown in Figure 283.

Torque all bolts twice to 15-18 lbs. ft. [20-25 N•m] in the sequence shown in Figure 283.

Re-calibrate the transmission.

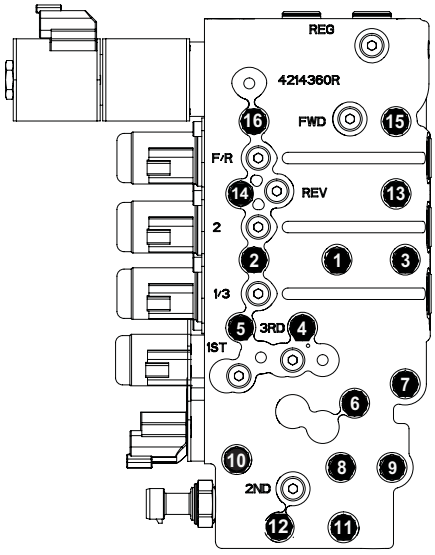


FIGURE 283: Control valve bolt tightening sequence.

FIGURE 284: Install speed sensors (4) and tighten to specified torque. See “Torque Specifications”, on page 131.

TORQUE SPECIFICATIONS

Lubricated or Plated Screw Threads

	Grade 5			
	Fine Thread		Coarse Thread	
Size	lbs. ft.	N•m	lbs. ft.	N•m
1/4” (.2500)	9 - 11	12.2 - 14.9	8 - 10	10.8 - 13.6
5/16” (.3125)	16 - 20	21.7 - 27.1	12 - 16	16.3 - 21.7
3/8” (.3750)	26 - 29	35.2 - 39.3	23 - 25	31.2 - 33.9
7/16” (.4375)	41 - 45	55.6 - 61.0	37 - 41	50.2 - 55.6
1/2” (.5000)	64 - 70	86.8 - 94.9	57 - 63	77.3 - 85.4
9/16” (.5625)	91 - 100	123.4 - 135.6	82 - 90	111.2 - 122.0
5/8” (.6250)	128 - 141	173.5 - 191.1	113 - 124	153.2 - 168.1
3/4” (.7500)	223 - 245	302.3 - 332.1	200 - 220	271.1 - 298.2

	Grade 8			
	Fine Thread		Coarse Thread	
Size	lbs. ft.	N•m	lbs. ft.	N•m
1/4” (.2500)	11 - 13	14.9 - 17.6	9 - 11	12.2 - 14.9
5/16” (.3125)	28 - 32	38.0 - 43.4	26 - 30	35.2 - 40.7
3/8” (.3750)	37 - 41	50.2 - 55.6	33 - 36	44.7 - 48.8
7/16” (.4375)	58 - 64	78.6 - 86.8	52 - 57	70.5 - 77.3
1/2” (.5000)	90 - 99	122.0 - 134.2	80 - 88	108.4 - 119.3
9/16” (.5625)	128 - 141	173.5 - 191.1	115 - 127	155.9 - 172.2
5/8” (.6250)	180 - 198	224.0 - 268.4	159 - 175	215.5 - 237.2
3/4” (.7500)	315 - 347	427.0 - 470.4	282 - 310	382.3 - 420.2

METRIC FASTENERS						
Lubricated and Plated Bolts, Capscrews, and Studs						
	Class 8.8		Class 10.9		Class 12.9	
	8.8 on Bolt Head		10.9 on Bolt Head		12.9 on Bolt Head	
Size	lbs. ft.	N•m	lbs. ft.	N•m	lbs. ft.	N•m
M5	3.7 - 4.4	5 - 6	5.2 - 5.9	7 - 8	5.9 - 7.4	8 - 10
M6	5.9 - 7.4	8 - 10	8.9 - 11.1	12 - 15	9.6 - 11.8	13 - 16
M8	14.8 - 18.4	20 - 25	22.1 - 25.8	30 - 35	25.8 - 29.5	35 - 40
M10	29.5 - 36.9	40 - 50	44.3 - 47.9	60 - 65	47.9 - 55.3	65 - 75
M12	50.2 - 55.3	68 - 75	73.8 - 81.1	100 - 110	84.8 - 95.9	115 - 130
M14	81.1 - 92.2	110 - 125	110.6 - 129.1	150 - 175	132.8 -154.9	180 - 210
M16	125.4 - 140.1	170 - 190	177.0 - 202.8	240 - 275	206.5 - 236.0	280 - 320
M20	236.0 - 265.5	320 - 360	331.9 - 368.8	450 - 500	387.2 - 442.5	525 - 600
M24	420.4 - 479.4	570 - 650	590.1 - 663.8	800 - 900	663.8 - 774.4	900 - 1050
M30	848.2 - 958.8	1150 - 1300	1180.1 -1327.6	1600 - 1800	1364.5 - 1548.9	1850 - 2100
M36	1475.1 - 1659.5	2000 - 2250	2028.3 - 2323.3	2749 - 3149	2397.1 - 2729.0	3249 - 3699

O-ring Port Plug

Size (NPTF)	lbs. ft.	N•m
1/16 x 27	5 - 7	7 - 9
1/8 x 27	7 - 10	9 - 14
1/4 x 18	15 - 20	20 - 27
3/8 x 18	25 - 30	34 - 41
1/2 x 14	30 - 35	41 - 47
3/4 x 10	40 - 45	54 - 61
3/4 x 14	40 - 45	54 - 61
1 x 11.5	50 - 55	68 - 75
1-1/4 x 11.5	60-65	81 - 88

Size	lbs. ft.	N•m
M10 X 1	6 - 7	8 - 10
M14 X 1.5	7 - 9	10 - 12
M18 X 1.5	25 - 30	34 - 41
M22 X 1.5	35 - 44	48 - 60
M33 X 2	83 - 103	112 - 140

Pipe Plugs

Size (NPTF)	lbs. ft.	N•m
M18 x 1.5 6H	34 - 41	25 - 30
M26 x 1.5 6H	61 - 68	45 - 50

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